Cellular phone outlook • Japan's workstation fever

SIX DOLLARS

A CAHNERS PUBLICATION

C1850-2A

Electronic Business®

FOR MANAGEMENT IN ELECTRONICS, COMPUTER & SYSTEMS COMPANIES — WORLDWIDE

MARCH 19, 1990

THE U. S. ELECTRONICS INDUSTRY

CHALLENGES FOR THE 1990s

Exclusive survey of 750 chief executives by Electronic Business and Ernst & Young

CAPITAL FUNDING • GLOBAL COMPETITION • STRATEGIC ALLIANCES • GOVERNMENT ACTIONS — How you and your company can benefit from the industry leaders' views on the opportunities, uncertainties and pitfalls in the decade ahead.

JAMES TREYBIG, CEO, TANDEM COMPUTERS

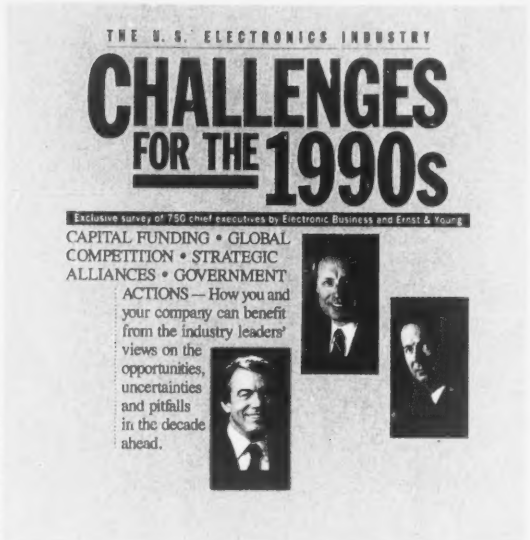
ROD CANION, CEO, COMPAQ COMPUTER

JAMES MORGAN, CEO, APPLIED MATERIALS

Electronic Business

FOR MANAGEMENT IN ELECTRONICS, COMPUTER AND SYSTEMS COMPANIES—WORLDWIDE

VOL. 16, NO. 6 MARCH 19, 1990


THE U.S. ELECTRONICS INDUSTRY
CHALLENGES FOR THE 1990s
Exclusive survey of 750 chief executives by Electronic Business and Ernst & Young
CAPITAL FUNDING • GLOBAL COMPETITION • STRATEGIC ALLIANCES • GOVERNMENT ACTIONS—How you and your company can benefit from the industry leaders' views on the opportunities, uncertainties and pitfalls in the decade ahead.

Cover photographs by James Tevlin by Jamie Tanaka Rod Canion by Jonathan Levine

33 The CEO's job is to think strategically: know the market, handle uncertainty and keep ahead of the pack. Successful strategies lead to faster sales growth and increased profitability. That's what the person in the corner office does. To see how chief executives are facing the challenges of the 1990s, ELECTRONIC BUSINESS and "Big Six" accounting firm Ernst & Young polled more than 750 U.S. electronics industry CEOs.

44 **Globalization is the driving force**
Although foreign competition is intense now, many CEOs expect it to get worse in the future. Indeed, foreign competition is driving many companies' strategic concerns.

52 **The changing structure of capital formation**
Capital is the dominant issue today. Where it comes from, how much it costs and how it will be used are shaping the industry of tomorrow.

58 **Shift in focus for strategic alliances**
Partnering is on the upswing for technology, product development and manufacturing. But not all alliances are growing in popularity.

64 **Electronics and government: A wary association**
Government may become more of a friend to industry, as both battle foreign competition and try to build a stronger business environment.

73 **What the leaders think**
Interviews with leading CEOs provide a glimpse of what they see as the key strategic issues for their companies and for the future directions of the electronics industry.

89 **Defining electronics**
A microcosm of the U.S. electronics industry. A look at the companies surveyed, their markets and where they operate.

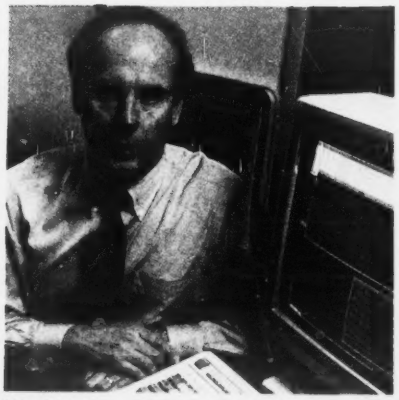
97 **The emerging pyramid of new priorities**

99 **The R&D race goes to the fittest**

BUSINESS TRENDS

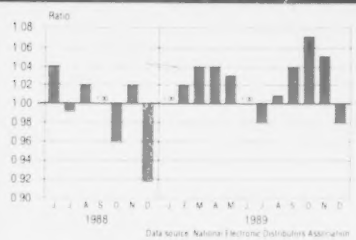
19 **U.S. workstations are a big hit in Japan**
Japan is in the midst of a roaring boom for workstations. After a slow start in 1983, the Japanese market for these high-performance desktop computers is growing at the rate of 35% annually. U.S. companies are the biggest beneficiaries, with Sun, DEC and HP's Apollo subsidiary controlling 55% of the market.

25 **When will it be time to transfer to the VXIbus?**
By the end of this year, the shape and performance of in-house test systems will be changing. This will be the year the marketplace begins to accept VXIbus. VXI-based products are coming to market at an increasing clip, and customers must decide whether to switch to this alternative from the prevailing general purpose interface bus architecture.



PAGE 115 Data General's George Dobble: Leasing gives customers a short-notice opportunity to upgrade

Distributors' book-to-bill slips in December...



PAGE 165 Business Barometer: Distributor orders slow at year-end

PAGE 105 MRS Technology's Griffith Resor: "Looking for real solutions to our trade problems"

PAGE 122 BellSouth's Jo Ann Blount: Devising strategies to move smoothly from analog to digital cellular phones

PAGE 19 Nihon Sun's Kazumasa Nishida: Celebrating the workstation boom in Japan

STRATEGIES

105 **For want of U.S. customers, MRS exports its technology**

Griffith Resor, president of MRS Technology, is an outspoken critic of the weakening U.S. trade position against Japan. Yet the irony is not lost on Resor that he makes his living manufacturing and selling equipment to Japanese companies that then use it to make the flat panel displays for TVs, laptops and other products that give Japan its trade advantage.

MANAGING RESOURCES

115 **Falling profits, tight credit boost demand for lease deals**

With cash flow slowing, credit costs rising and computer hardware technology advancing at a heady pace, more and more corporate managers are asking for special leasing arrangements to help them reduce the risk of an outright purchase. And most computer companies are responding — some offering their own strong lease marketing deals and others packaging sales with third-party equipment lease vendors.

MARKET PERSPECTIVES

122 **Gridlock on the airways blocks U.S. cellular growth**

While racking up record revenue, cellular phone carriers are struggling to cram new subscribers into a system already straining under the current load. An emerging digital standard promises relief, but industry bickering over a few technical points could delay its ratification. Just how long will the switch to digital take?

EUROPE BUSINESS

147 **U.S. companies mobilize to answer Europe's call**

Global suppliers of cellular phone equipment and services — including several from the United States — are scurrying to Europe to join international consortia bidding for contracts that could easily dwarf those in the U.S. market. The alliances are functioning as trading bazaars, letting U.S. companies swap technology for their European partners' home-market clout.

BUSINESS BAROMETER

165 **Distribution**

A strong surge in new orders may be a leading indicator of a stronger 1990 ahead.

166 **Components**

With backlogs creeping up, the likelihood of a severe decline in shipments remains remote.

DEPARTMENTS

5 **Inside Business**

9 **Letters**

13 **Upstarts**

Clear Communications, Elite Microelectronics, Real Database

159 **My View**

Commerce without morality

160 **Advertiser index**

168 **Viewpoint**

Why can't they be more like us?

COMPANIES IN THIS ISSUE

156 **An Index of the companies covered in this issue.**

EDITORIAL STAFF

Publisher: Frank J. Burge

Editor: Jeffrey Bairstow

Managing Editors: J. William Semich, Roger C. Plant

Senior Editors: Linda Stallmann (Financial), Bruce C. P. Rayner, Rick Whiting, Barbara N. Berkman

Associate Editor: Michael R. Leibowitz

Assistant Editors: Peter L. Burrows, Xiong Xiaoge

Section Editor: Marvin V. Greene

Copy Editor: Barbara Jorgensen

Research Editor: Michelle D. Doses

Contributing Editors: Elizabeth Baatz (Cahners Economics), Dwight B. Davis (Boston), H. Garrett DeYoung (Boston), Madeline Franchi (Cahners Economics), Sarah Glazer (Boston), Shohei Kurita (Tokyo)

Consulting Editors: Alberto Socolovsky, Allen Furst

Production Editor: Karen J. Covey

Editorial Assistant: Jean O'Brien

ART STAFF

Art Director: Michael Roach

Associate Art Director: Carla Aguilar Leeder

Staff Artist: Michele G. Kane

EDITORIAL OFFICES

Boston: Cahners Building
275 Washington Street, Newton, Mass. 02158
(617) 964-3030 Telex 94 0573 CPC BSN
Fax (617) 558-4327 MCI EBBOS

Washington, D.C.:
1333 F Street, N.W., Suite 720
Washington, D.C. 20004 (202) 628-2773

San Jose, Calif.: Michael R. Leibowitz
Sherman Building, 3031 Tisch Way, Suite 100
San Jose, Calif. 95128 (408) 296-0868

Northwest: Paula Doe
5011 133rd Place SE
Bellevue, Wash. 98006 (206) 641-0903

London: Barbara N. Berkman
27 Paul Street
London EC2A4JU England 011-44-1-628-7030
Fax 011-44-1-628-5984

PRODUCTION

VP Production: Wayne Hulitzky

Director of Production/Manufacturing: John R. Sanders

Production Supervisor: Andrew A. Jantz

Production Manager: Betsy Harkins, (617) 964-3030

CIRCULATION

Circulation Manager: Ann Ward
44 Cook Street, Denver, Colo. 80206
(303) 388-4511

Total Circulation: 77,804

REPRINTS

ELECTRONIC BUSINESS articles are available on a custom printing basis at reasonable prices. Contact Andrea Marwitz, Cahners Reprint Service, Cahners Plaza, 1350 E. Touhy Ave., P.O. Box 5080, Des Plaines, Ill. 60018 (708) 635-8800. Electronic Business can be purchased on 35mm microfilm through University Microfilm Int. Periodical Entry Dept., 300 Zeeb Road, Ann Arbor, Mich. 48106.

When CEOs talk, we listen

It's gratifying to know that CEOs are usually willing to give ELECTRONIC BUSINESS a few minutes of their valuable time when we call. As reporters we need to talk to business leaders for insightful coverage of the industry. But nothing prepared us for the overwhelming response we got when we teamed up with Ernst & Young, one of the "Big Six" accounting firms, to do a comprehensive survey of strategic issues facing chief executives in the U.S. electronics industry. Of the 3,200 surveys we mailed, 774 were returned. Twenty-four percent is an astonishing response rate.

But it didn't stop there. We asked some of the big names in the industry to give us an hour of their time so we could explore the critical issues of the day in more depth. We also held four round-table discussion groups with more than 30 CEOs of both large and small companies. The cooperation was enthusiastic and the results informative. When the interviewing was over we had a stack of tape transcripts more than a foot high.

When the surveys were returned and the interviews transcribed, we discovered what teamwork really means. ELECTRONIC BUSINESS' editor Jeffrey Bairstow and I spent long hours in conference with several members of Ernst & Young's High Technology Industry Services Group in San Francisco, sifting, analyzing and compiling the information that is contained in this report.

Many hands went into analyzing the results, but special thanks go to Steven Burrill and Stephen Almassy, both national directors at Ernst & Young, for their energy in putting this project together. Kathleen Reichert, director of marketing for Ernst & Young's High Tech Group, masterfully coordinated the project, while Kyle Kelhofer, industry analyst with the High Tech Group, did an outstanding job of crunching the numbers. As for me, I spent a good month and a half on the road with various Ernst & Young partners conducting interviews and another month chained to my computer writing at a feverish pace.

We know you'll find the information contained in this special report both comprehensive and useful. Perhaps its greatest use will be for your own company's planning. That is, until next year's survey is published. We are already preparing for it now.

BRUCE C.P. RAYNER, senior editor

Senior editor Bruce Rayner

ELECTRONIC BUSINESS® (ISSN 0163-6197) is published bi-weekly, except monthly in December, by The Cahners Publishing Company, A Division of Reed Publishing USA, 275 Washington Street, Newton, MA 02158-1630. Terrence M. McDermott, President; Frank Sibley, Senior Vice President/General Manager, Boston Division; Jerry D. Neth, Senior Vice President/Publishing Operations; J.J. Walsh, Senior Vice President/Finance; Thomas J. Dellamaria, Senior Vice President/Production and Manufacturing; Ralph Knupp, Vice President/Human Resources. Circulation records are maintained at Cahners Publishing Company, 44 Cook Street, Denver, CO 80206-5800. Telephone: (303)388-4511. Second-class postage paid at Denver, CO 80206-5800 and additional mailing offices. POSTMASTER: Send address corrections to ELECTRONIC BUSINESS® at the Denver address. ELECTRONIC BUSINESS® copyright 1990 by Reed Publishing USA; Ronald G. Segel, Chairman and Chief Executive Officer; Robert L. Krakoff, President and Chief Operating Officer; William M. Platt, Senior Vice President. Annual subscription rates for non-qualified people: USA, $79.95; Canada, C $99.95; other countries, $120 per year; $100, air mail surcharge. Except for special issues where price changes are indicated, single copies of regular issues are available for $10.00 (USA, Canada/Mexico and foreign). Please address all subscription mail to Eric Schmierer, 44 Cook Street, Denver, CO 80206-5800. Cahners Publishing Company, A Division of Reed Publishing USA • Specialized Business Magazines for Building & Construction • Manufacturing • Foodservice & Lodging • Electronics & Computers • Interior Design • Printing • Publishing • Industrial Research & Technology • Health Care • Entertainment. Specialized Consumer Magazines: American Baby • Modern Bride.

BPA ABP

When will it be time to transfer to the VXIbus?

Is VXIbus the ATE interface of the future? Fewer than 1,000 customers think so; the rest await more complete systems

By the end of 1990, the shape and performance of in-house test systems will be changing. Vendors and analysts agree that this will be the year the marketplace begins to accept VXIbus, a modular instrument interface that enables manufacturers to assemble in-house test and measurement systems that are smaller, faster and more flexible than conventional rack-and-stack systems.

VXI-based products are coming to market at an increasing clip, and customers are deciding whether to switch to this alternative from the prevailing general purpose interface bus (GPIB) architecture.

With VXI, users can replace these rack-and-stack systems with a modular setup composed of a card-cage and up to 13 instruments on a card. These systems are up to two-thirds smaller than their GPIB counterparts and their faster processing speeds help increase throughput. A common backplane replaces the cords, cables and other accessories necessary to link GPIB-compatible products; the results are reduced hardware costs and improved system performance due to more accurate synchronization of instruments.

The easily interchangeable cards make VXI an attractive option for manufacturers who need to test a wide variety of devices and boards. Larry Des Jardin, VXI technical program manager for Hewlett-Packard Co., says that the VXIbus can reduce test program development time from months to days. In addition, he says, "There will be measurements in the future that only VXI will be able to test" because of increased chip integration and complexity.

VXIbus has its limitations. Card cages are too small and heat-sensitive to hold all but the smallest power supplies. It is uncertain whether finely tuned tools such as calibrators will be able to perform when crammed in a box with less vibration-sensitive instruments. Software for many applications is poor or nonexistent. And many vendors wonder why customers would invest thousands of dollars just to obtain smaller system footprints and marginal performance improvements.

But the brief history of the VXIbus indicates that this revolution is accelerating. The architecture was originally conceived by the U.S. Air Force as a means to downsize test systems to fit in airplane cockpits. Commercial vendors embraced the emerging standard from the start; early on, they developed the VXIbus to be compatible with the VMEbus — the backplane standard for the computer industry — to extend VXI as far as possible into both military and commercial markets. VXI stands for VMEbus Extensions for Instrumentation.

In July 1987, industry giants Hewlett-Packard, Racal-Dana Instruments Inc. and Tektronix Inc. formed the VXI consortium with Colorado Data Systems Inc. and Wavetek Corp., which were already working on proprietary modular interfaces. Since then, 38 other companies have signed up, and between 40 and 50 currently are marketing VXIbus-compatible products, according to Fred Bode, publisher of the VXI newsletter in La Mesa, Calif. A year ago, there were less than 50 such products on the market, says Bode; as of mid-January, there were 182.

The proliferation of new products represents a giant step forward for the new standard, observers say. "A lot of people signed on [with VXI] in spirit and then looked around and found there were no products," says Bode. "That has changed in the past six months, and people are finally able to do the things they want to do with VXI." Rather than make large investments to add only a smat-

Corey Hirsch, a manufacturing manager with Tektronix: "VXI will be for instrumentation what VLSI was for components"

tering of VXI instruments to their GPIB systems, customers can now buy most of what they need to assemble a total VXI-based operation, from card-cages to embedded controllers to matrix switches.

Customer interest continues to lag behind vendor enthusiasm; fewer than 1,000 VXI systems have been sold worldwide, sources say. But observers predict slow, steady growth for the foreseeable future. "It's been accepted by all the vendors; it's only a matter of time before customers do, too" says Corey Hirsch, a manufacturing manager with Tektronix. "VXI will be for instrumentation what VLSI was for components."

Approaching critical mass

Galen Wampler, president of San Jose-based market research firm Prime Data, expects the market for VXI-compatible instruments and card-cages to enjoy 55% compounded annual growth through the year 2000, from around $20 million in 1989 to $2.5 billion. At that time, VXIbus could be the standard architecture for around 20% of the $19 billion test instrument market.

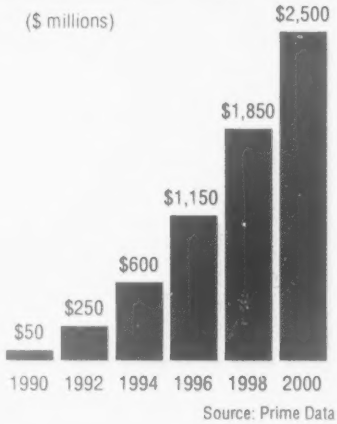
"It's a critical mass thing," says Stephen Balog, an analyst with Shearson Lehman. "When there's enough products out there, then bang, you've got a standard. We're probably very close to that critical mass; there's enough pieces of the puzzle out there. This is not a fad."

General interest is starting to snowball among commercial manufacturers. A focus group organized by Bode in late 1989 revealed that only three of 60 potential users currently used VXI products, but that 80% planned to do so within the next year.

Rick Wegner, senior engineering manager of Storage Technology Corp., Louisville, Colo., cut the size of his conventional test systems by 66% through VXI technology. He now requires his engineers to search for VXI solutions before purchasing GPIB-compatible equipment. "Lots of companies are taking a wait-and-see approach because they think [VXI is] too expensive. But we wanted to be far along on the learning curve when the prices started to come down."

Market leaders Hewlett-Packard and Tektronix both have introduced broad product lines in the hopes of improving their positions in the VXI era. HP unveiled 29 new products on Sept. 1, 1989, and Tektronix, along with newly purchased Colorado Data Systems, offers 40 products. "Our strategy," says HP's Des Jardin, "is to offer enough modules for a person to do a meaningful set of tasks with VXI." Tektronix takes a similar view; general manager Larry Moulton proudly proclaimed at a January press conference that "we can fill 80% of the needs of 100% of our customers."

High hopes for VXI instrument sales



Source: Prime Data

But other vendors have chosen to hurry up and wait. Companies including Bruel & Kjaer Instruments Inc., John Fluke Manufacturing Co. Inc., and Keithley Instruments Inc. have designed and even produced VXI-compatible instruments, but none currently are marketing these products. "Customers are telling us they're leaning toward VXI in the future, but not to the extent that people have been pouring money into it," according to Fluke sales manager David Shapiro. "HP and [Tektronix] may be able to move the market by pushing VXI so hard, but having a wide breadth of products doesn't mean they are satisfying customers."

"None of the products introduced so far can be described as breakthrough products, and they generally don't offer the same level of performance" as current GPIB-based products, says Frederick R. Hume, vice president and general manager of Keithley's instruments division. Hume says that while some Keithley customers have expressed interest in VXI, most cannot get sufficient results with it yet. "These users want the best of everything because they have so many different jobs to do," he says, "but it does no good if you can test 90% of something. You have to test 100%."

The biggest problem for VXI in the short term may be a lack of quality software. Test engineers, already put off by the new architecture's graphical interface, require programs that are not only effective but which simulate the knobs, buttons and other manual controls they have come to know and love in test instrumentation.

"There's 50 years of history in GPIB, ever since the first oscilloscope," says Ron Wolfe, strategic marketing manager at National Instruments Corp., an Austin, Texas-based embedded controller manufacturer and software developer. "You give up that familiarity with a VXI system, so the software has to provide a way for test engineers to control things as they want to." To solve this problem, National Instruments and others offer software packages that simulate a front panel.

Until the technical limitations of VXIbus are solved and vendors offer a truly comprehensive universe of products, users will continue to integrate available VXIbus products into their GPIB systems.

Tactical concerns for VXIbus

Observers expect a VXIbus-dominated market to be wild and woolly compared with the GPIB era, which has been dominated from the start by Hewlett-Packard, the founder of that standard. The secrets to success will include offering a wide enough range of products to offer full solutions. The most successful firms will also provide superior service, training and other added value. "This will be a systems game," according to HP's Des Jardin.

The transition from GPIB may never be total, but the pace will pick up in 1990 as VXIbus graduates from a buzzword into a full-fledged trend. For now, vendors will continue to lead customers into the future. "In terms of market share, VXI is pretty small," says National Instrument's Ron Wolfe. "But in terms of mindshare, it's huge."

PETER BURROWS

THE U. S. ELECTRONICS INDUSTRY

CHALLENGES FOR THE 1990s

The critical concerns of CEOs today will become hard reality tomorrow. Their thinking on these issues will shape business strategies and future directions for their companies. This exclusive ELECTRONIC BUSINESS/Ernst & Young survey of chief executives captures those key concerns and provides an extensive overview of the state of the U.S. electronics industry. For CEOs, the most critical matters are globalization, capital, alliances and government. How chief executives will respond to these issues will determine the future of the industry. This survey provides informative insight so you can better chart your company's course for tomorrow.

Comstock

Exclusive survey of 750 chief executives by ELECTRONIC BUSINESS and Ernst & Young

OVERVIEW

34 How U.S. electronics CEOs will address the new competitive priorities

The significant survey results and the perspectives of industry leaders on the opportunities for success in the decade ahead

CRITICAL ISSUES

44 Globalization is the driving force

Where the threats and opportunities lie in the increasingly competitive international markets and how CEOs are responding

52 The changing structure of capital

Capital is the dominant issue today. Where it comes from, how much it costs and how it will be used are shaping the industry of tomorrow

58 Shift in focus for strategic alliances

Partnering is on the upswing for technology, product development and manufacturing but not all alliances are growing in popularity

64 Electronics and government

Government may become more of a friend to industry as both battle foreign competition and try to build a stronger business environment

EXECUTIVE INSIGHTS

73 What the leaders think

One-on-one interviews with leading CEOs on the key strategic issues for their companies and the future directions for the industry

METHODOLOGY

89 Defining electronics

A microcosm of the U.S. electronics industry. A look at the companies surveyed, their markets and where they operate

VIEWPOINTS

97 The pyramid of new priorities

99 The R&D race goes to the fittest

How U.S. electronics CEOs will address the new competitive priorities

The significant survey results and the perspectives of industry leaders on the opportunities for success in the decade ahead

BY BRUCE C.P. RAYNER

The CEO's job is to think strategically: know the market, handle uncertainty and keep ahead of the pack. Shareholders demand it, customers expect it and suppliers depend on it. Successful strategies lead to faster sales growth and increased profitability. That's what the person in the corner office does.

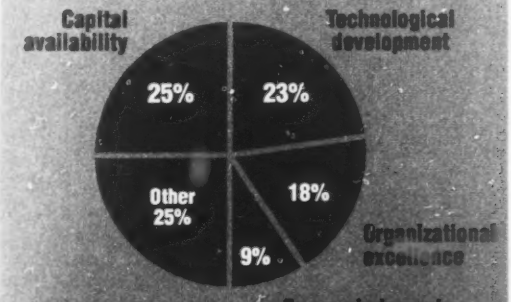
To see how chief executives are facing the challenges of the '90s, ELECTRONIC BUSINESS and Ernst & Young, one of the "Big Six" accounting and management consulting firms, polled over 750 of the U.S. electronics industry's CEOs and conducted many in-depth interviews.

Although no two companies are alike, there are several common, critical concerns among top executives. Throughout the survey and in many of the interviews, capital constraints struck the most resounding chord. The availability of capital is the most demanding issue facing CEOs today, according to the survey's respondents (Chart 1).

CHART 1

TODAY'S NO.1 CHALLENGE

Q • What is your company's number one • problem area or challenge today?



Other challenges include: Product quality (4%), distribution conflicts (4%), evolving standards (3%), international trading environment (3%), component costs (2%)

Percentage of total respondents

Capital constraints are closely followed by technological development as the second most important concern facing CEOs. Even though individual CEOs are often optimistic about the futures of their companies, a sense of pessimism pervades the industry. Sixty-nine percent of all survey respondents believe that the United States is losing its technological edge. While the United States will continue to be strong in software and computer-aided design and manufacturing (CAD/CAM), the country will slip, relative to its major trading partners, in all areas. The hardest-hit segments will be microprocessors and computers (Chart 2).

The lack of ready capital and its high cost are blamed for everything from the declining number of start-ups to America's losses in technological superiority. For semiconductor companies, the issue is the sheer volume of capital needed for developing new technologies and manufacturing facilities. For start-ups, the key question is how to attract the attention of jaded venture capitalists.

For all companies, equity will continue to be the primary source of funding. Private equity is expected to account for over 20% of the total funding needs in five years, down from 43% today, while public equity will triple, to 30%. Debt and private equity will both decline as a percent of the total funding needed. Close to half of all CEOs expect to go to the public markets within the next five years, either for an initial public offering or for a subsequent round of financing (Chart 3).

Wherever capital comes from, the majority of chief executives expect to spend increasing amounts to build new facilities. While 13% expect to build in 1990, 53% expect to build between 1991 and 1995. The vast majority of facilities will go up in the United States, with Europe coming in a distant second and the Pacific Rim an even more distant third.

Research and development will

also place increasing demands on capital funds. Total R&D spending as a percent of sales will grow from an average of 9.5% of sales today to 9.8% in five years, according to the survey. The biggest growth will come from large companies in the communications, semiconductor and semiconductor equipment markets. For instance, the semiconductor market segment expects to increase R&D spending from 9.0% of sales today to 9.9% by the year 1995 (Chart 4).

Thomas Sege, chairman, Varian Associates

However, sources indicate that the rate of growth in R&D spending in the United States has been slowing in recent years and might continue that trend. Indeed, surveyed computer makers, industrial electronics companies and software vendors all plan to spend a lower percentage of sales on R&D over the next five years. Part of the problem is that competitive pressures are squeezing profits and putting the pinch on retained earnings. "Japanese competition [has] driven prices so low we can't afford development costs," laments one executive.

Executives are disturbed by the high relative cost of capital between the United States and Japan. Many CEOs complain that the cost of capital in Japan is less than half that in the United States. Adding to the capital burden in the United States is double taxation of corporate profits and dividends and the rescinding of the investment tax credit in 1986, say several executives.

Wall Street's short-term focus on quarterly performance has CEOs frustrated, too. Some 76% of all respondents believe that their industry's long-term prospects are constrained by the need to show quarterly improvements. Even venture capitalists are seen as bad guys because of their micromanagement and focus on very high return on investment. "Venture capital will be the death of high technology," comments one irate CEO.

But many CEOs are more pragmatic about the whole short-term/long-term debate and accept the constraints as part of the price of doing business. However, some CEOs think there is inadequate long-term planning in the industry and argue forcefully for a national technology policy. These executives point to national security as one reason to maintain a viable electronics industry.

"We are one of the few major countries that not only doesn't have an industrial policy, but thinks that those words are dirty words," comments Thomas Sege, chairman and chief executive of Varian Associates Inc. in Palo Alto, Calif. "There is a European industrial policy developing. Japan has had it for a long time. Korea has had it, we don't," he complains.

"WE ARE ONE OF THE FEW MAJOR COUNTRIES THAT NOT ONLY DOESN'T HAVE AN INDUSTRIAL POLICY, BUT THINKS THAT THOSE WORDS ARE DIRTY WORDS"

Varian's Thomas Sege

Working smarter

Capital contraints and competitive pressures are forcing CEOs to focus more strongly on their company's customers. Seventy-one percent of all CEOs surveyed think customer service will be a "very important" challenge in the next five years (Chart 5). Similarly, competitive advantage is determined by many criteria, but customer service is the only determinant that CEOs expect to become significantly more important in the future (Chart 6).

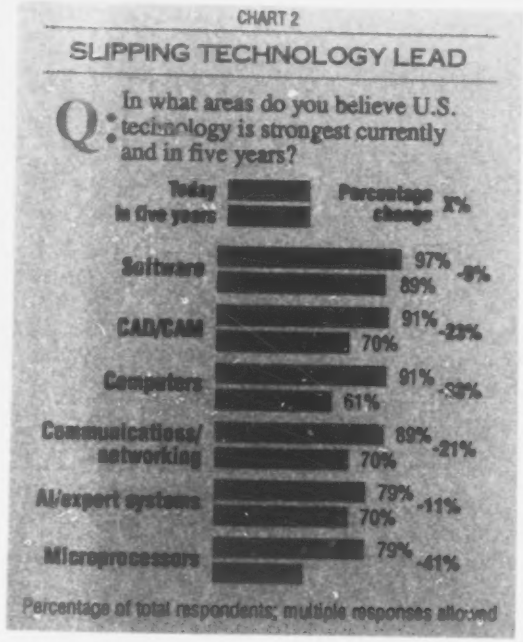
To deal with the challenges of the decade ahead, CEOs agree their companies must learn to work smarter. Reliance on government aid or protection is not popular. There is acceptance that the motivation to face the issues starts with the chief executive.

At the heart of a smarter company is the need to focus on the customer and develop a corporate culture of organizational excellence. Eighteen percent of the surveyed CEOs claim organizational excellence is the most critical issue they face today. That means higher quality in

CHART 2

SLIPPING TECHNOLOGY LEAD

Q: In what areas do you believe U.S. technology is strongest currently and in five years?



Percentage of total respondents; multiple responses allowed

"THE '90S WILL BE A TIME WHEN THERE CONTINUES TO BE TREMENDOUS CHANGE TOWARD STANDARDS, WHICH PUTS A BURDEN ON COMPANIES THAT CONTINUE TO SEARCH FOR AN ADVANTAGE"

every facet of the company's business, from technology to manufacturing to personnel.

Organizational excellence and customer service are tightly coupled. "The only way to find out whether you are excellent or not is by asking the customer," according to Winston Hindle, senior vice president of operations at Digital Equipment Corp. "The only set of standards that make any sense to judge yourself on are those set by the customer."

James Treybig, chief executive and president, Tandem Computers

"Just having a unit that doesn't break as often as the next guy's isn't enough," insists Rod Canion, chief executive of Compaq Computer Corp. What's needed is the right product — one that meets the needs of the customer and satisfies expectations. But while the United States has been doing a better job serving the customer in recent years, it still has a long way to go, admits Canion.

Meeting customer needs means keeping pace with advances in technology and applying technology quickly to new product development. Larger companies are most concerned with technological obsolescence, while small and midsized companies worry more about protecting their proprietary technology. The solution to both problems lies in more technology exchanges in the 1990s, according to survey results.

Although technology development is a critical issue for the 1990s, many CEOs feel that having leading-edge technology is no longer enough to maintain a competitive advantage. Technology is only an invitation to participate, says Robert Schultz, chief executive of GM Hughes Electronics Corp. and executive vice president of General Motors Corp. "You have to have technology, but that's not going to be enough to win. You have to have the cost [structure] and the quality and the reputation to be a player in the marketplace," he says.

Closer ties

The "Not Invented Here" arrogance so prevalent in the 1970s and early 1980s is giving way to cooperative technology development among competitors and between suppliers and customers. Microcomputer manufacturers, for example, rely on microprocessor makers for a large part of the technology that goes into their systems.

At the same time, evolving standards are helping to establish closer relationships. "The '90s will be a time when there continues to be tremendous change toward standards, which puts a burden on companies that continue to search for advantage," says James Treybig, chief executive of Tandem Computers Inc.

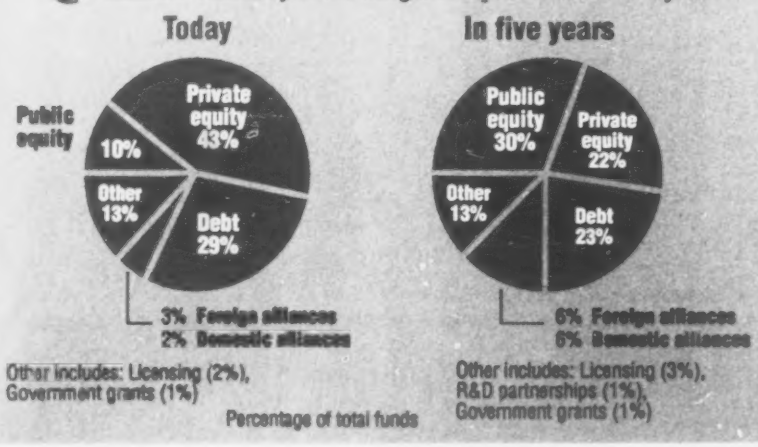
One CEO is improving customer relations by buying his customers' stock and giving it to his own employees as a bonus. The stock purchases improve morale and have an effect on the quality of the products, says John Hanley, president of Chantal Systems Corp., a San Diego-based software developer.

But some U.S. electronics companies have a long way to go before suppliers and customers are truly partners. In electronics distribution, partnerships with customers are still rare. "You can count on both hands and both feet the number of true

CHART 3

WHERE CAPITAL COMES FROM

Q • Estimate, as a percentage of your total financing, the • financial vehicles you are using and expect to use in five years.



partnerships between distributors and customers today," says Stephen Kaufman, CEO of Arrow Electronics Inc., Melville, N.Y.

While customer service is a significant issue for all CEOs, it tends to be rated more highly by companies in the $25 million to $300 million annual revenue range. These are established companies, often on the fast growth track, that are heavily exposed to foreign competition. In terms of markets, communications companies, computer vendors and software firms are most concerned with customer service. In short, the higher the level of competition, the more the customer matters.

To raise the level of service, companies must be flexible enough to react quickly to a changing environment. Many CEOs favor a flat, decentralized management structure, in which problems are exposed immediately rather than being buried in bureaucracy. "Zero response time" is the name Steve Hui, chief executive of Everex Systems Inc., Fremont, Calif., gives to his company's corporate culture. "We rely on the possibility of people rather than the rigidity of our procedures," he says. Customer needs percolate up from sales and marketing, new ideas come from engineering and both flow to production and management.

People problems

For most companies, people are the key to competitive advantage. Indeed, a company is defined by the caliber of its employees. But many chief executives say finding and keeping good people will become more of a problem in the coming decade. It is rated as the second most important issue that CEOs expect to face during the next five years.

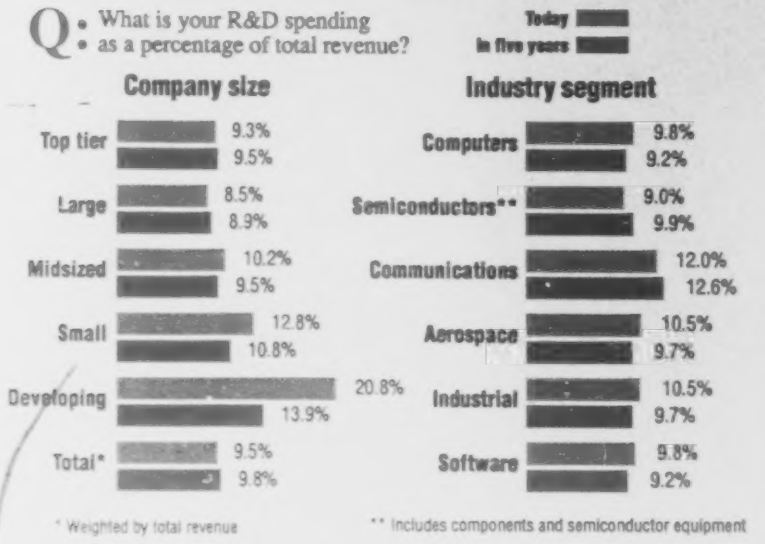
Hiring good people is often tied to other key concerns. Says one survey respondent: "Without adequate capital, we cannot afford the number and quality of employees needed to achieve our goals [of growth]."

The problem is twofold. First, how to find qualified candidates. The underlying problem here is in the quality of the education system. Many companies are forced to provide basic training in math and English in order for workers just to understand their jobs.

CHART 4

R&D SPENDING TO REMAIN CONSTANT

Q • What is your R&D spending • as a percentage of total revenue?



* Weighted by total revenue

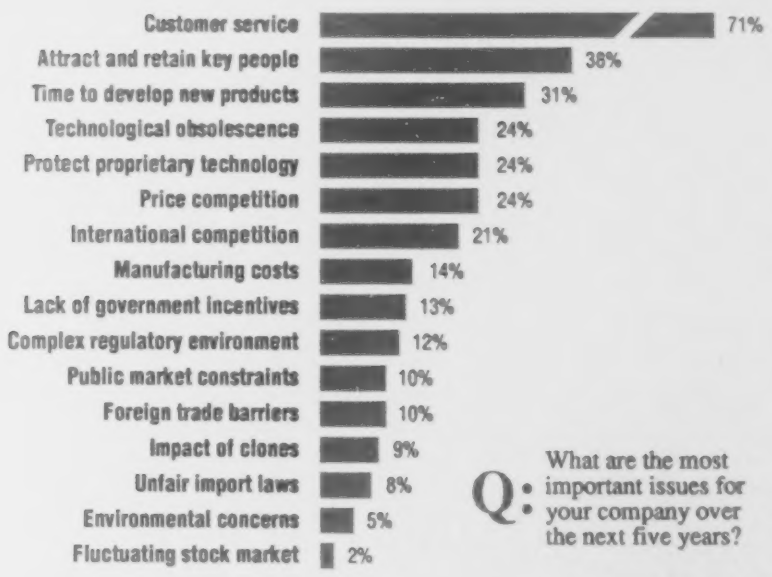
** Includes components and semiconductor equipment

With the gradual deterioration of the public education system in many areas of the United States, the attractiveness of studying math and science has also waned. Partly as a result, there has been a decline in the number of engineering graduates. Many science and engineering graduates are foreigners who must return home when they finish their studies. Competition for the best is getting fierce and will get worse in the future, say

CHART 5

BIGGEST CHALLENGES FOR THE NEXT FIVE YEARS

Percentage of total respondents; multiple responses allowed



Q • What are the most important issues for • your company over the next five years?

"WE SEE 1992 AS REALLY A MAJOR DRIVING FORCE IN THE EXPLOSIVE GROWTH OF THE EUROPEAN COMPUTER INDUSTRY TODAY"

Compaq's Rod Canion

worried chief executives. The situation "stinks," says Craig Barrett, executive vice president at Intel Corp.

The second problem is keeping employees once they have been hired. Mobility of skilled labor and the lure of higher pay elsewhere have created problems of continuity for many technology companies. CEOs recognize the need to create a continually challenging and supportive environment for their employees.

Rod Canion, chief executive, Compaq Computer

That involves empowering the employee, says Varian's Sege. Pride in accomplishments has to be instilled. But instilling pride in one's work is a long-term cultural change, and time is a critical issue. "Whether we can really create the motivation to have a more effective work force — that's the real question," says Sege.

Role of government

The government certainly has a role to play in improving education. But it also has a role to play in preserving the country's electronics industry. At the top of the list of concerns, surveyed CEOs think the government should provide better financial incentives for the industry. Popular suggestions include low-cost loans, a capital gains differential and more research and development incentives.

One factor in the high cost of capital is the government's budget deficit. A reduced budget deficit would help lower interest rates and bring capital costs down. Some 20% of CEOs see the budget deficit as the most serious macroeconomic problem for their own company's long-term health.

Even though government has a role to play, most CEOs think the Feds should stay at arm's length from the electronics industry. When dealing with trading partners, CEOs do not want protectionist walls built around their markets. Instead, the government should turn its attention to negotiating trade agreements at the highest, broadest levels, industry executives say. Japan is at the top of the list for such trade agreements, closely followed by Western Europe and the Pacific Rim countries.

While overseas trade agreements are favored, CEOs differ over the government's role in consortia. Aside from funding, the government's primary role in consortia should be to relax the anti-trust regulations, say several executives. At stake, say such consortia supporters, is the future of the electronics industry: in particular, the semiconductor and semiconductor equipment industries.

On the other hand, many CEOs question whether the cultural basis for consortia is lacking in the United States. "By and large, I'm not sure that competitors know how to deal with each other yet," says Edward Esber, chief executive of Ashton-Tate, Torrance, Calif., "whereas in Japan, consortia are ingrained and they work well."

Foreign markets

While competition with foreign companies is on the minds of most CEOs, it is not a high priority. International competition is ranked only seventh as a key business issue for the future, while foreign trade barriers and unfair import laws rank even lower.

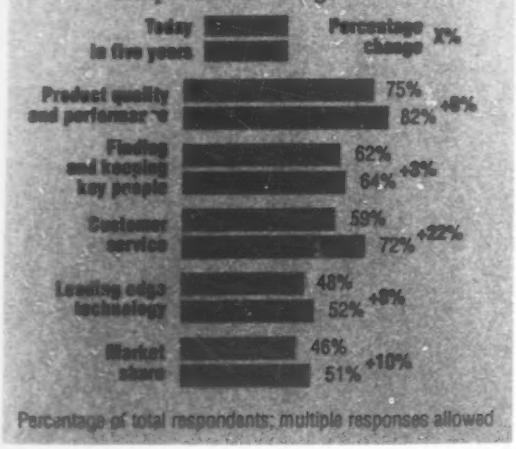
Foreign competition tends to be a big company issue. For companies generating between $100 million and $300 million in annual revenue, for instance, international competition, foreign trade barriers and unfair import laws are ranked sixth, seventh and eighth, respectively.

As expected, international competition is important for companies that face domestic competition from overseas companies. For instance, industrial electronics companies rate international competition fourth in terms of key issues, while semiconductor and semiconductor equipment makers rank it fifth. These

CHART 6

U.S. COMPETITIVE ADVANTAGES

Q: Rate the importance of the following in establishing your company's competitive advantage.



Percentage of total respondents; multiple responses allowed

companies also tend to be the most vocal about wanting tougher trade restrictions.

At the other end of the spectrum are software companies, which see little or no competitive pressures from overseas, particularly from the Far East. "I think it is difficult for the Japanese marketplace to develop software," says Charles Wang, chief executive of Computer Associates International, Garden City, N.Y., the largest software company in the industry. "I think their thinking is different. It is more structured, too structured almost."

However, Jon Shirley, former chief operating officer at Microsoft Corp., Redmond, Wash., doesn't think Japan should be ignored. "To the extent that there will be offshore competition [in software], I would most likely expect that it would come from Japan," says Shirley.

U.S. expansion overseas

As for expansion by U.S. companies into other geographic markets, Europe is considered by U.S. companies to be the most important foreign market to enter. Over the next five years, 43% of all CEOs surveyed expect to target Europe, up from 27% today.

The primary interest in Europe is fueled by the European Community's plans to dismantle intra-European trade barriers by the end of 1992. According to Compaq's Canion: "We see 1992 as really a major driving force in the explosive growth of the European computer industry *today*." As European businesses prepare for the changes coming during the next two years, they have to invest now in productivity-enhancing computer resources, Canion remarks.

Fifty-one percent of all CEOs think that the changes taking place in Europe will have a positive impact on their companies. Software companies are the most optimistic, while larger companies in all markets tend to be more pessimistic.

The dramatic changes occurring in Eastern Europe were unfolding as the survey was being conducted, so the impact of those events is difficult to assess. However, many CEOs interviewed at the end of 1989 believe that the main benefits of a freer Eastern Europe will go first to Western European companies, particularly West Germany. U.S. involvement won't be significant until the end of the decade, they claim.

TO DEAL WITH THE CHALLENGES OF THE DECADE AHEAD, CEOS AGREE THEIR COMPANIES MUST LEARN TO WORK SMARTER

As markets open up in Europe and elsewhere around the world in the 1990s, distribution is going to become a more pressing issue. But surprisingly, distribution channel conflicts are not considered serious problems by the majority of companies surveyed. However, many CEOs interviewed raised the issue of their company's distribution strategy as a key issue for the next few years.

Overall, distribution channel conflicts tied for fifth as the most critical issue of the day by all CEOs surveyed. In general, large communications and computer and peripherals companies rank distribution conflicts as relatively more serious compared to other company categories. The reason is that with a growing reliance on indirect distribution channels in these markets, particularly overseas, relinquishing control can create conflict.

"In the '90s, we're going to have to find newer and better ways to protect gross margins other than just straight price competition and I think the key to it is distribution channels," says Frank Buckley, vice president and general manager of Toshiba America Information Systems Inc.'s disk products division. That involves maximizing the economic life of products by using indirect distribution channels more effectively.

There are ways to supplement traditional distribution channels. Many companies are shifting toward telemarketing their products. Telemarketing accounts for a higher percent of sales than in the past and will continue to grow in importance, say many CEOs interviewed. This is being driven partly by the increasing cost of maintaining a field sales force and partly by the "consumerization" of electronics.

Distribution is critical

Distribution is also critical for companies that want to bolster international sales — especially in Europe — but are not ready to commit their own marketing and sales resources. Possibly this explains why large companies are more concerned about distribution channels. Larger companies are most likely to be on the threshold of international expansion and are most concerned about losing control of the marketing process.

Another important long term issue is the cost of distribution as a percent of sales. While electronics packages have gotten smaller and cheaper, the cost of getting them to the customer has remained constant, so the cost per sale of distribution has risen. "What we can't produce is the technology to sell the technology," according to Charles Foskett, CEO of Natural Microsystems Corp., a voice mail company in Natick, Massachusetts. The key, Foskett says, is to automate distribution.

Automation is most applicable to software distribution but remains a pipe dream. "It seems rather ludicrous that in the age of computers, we can't figure out how to do the appropriate electronic distribution of our products," says Ashton-Tate's Esber. □

Getting in touch with the industry

For reprints of this ELECTRONIC BUSINESS report call Andrea Marwitz at (800) 323-4958. The price per copy is $5 and quantity discounts are available. For a copy of Ernst & Young's report entitled "Electronics '90: The New Competitive Priorities," call Shawn Tillman at (415) 955-8395. The price is $50 per issue. □

Globalization is the driving force

Where the threats and opportunities lie in the increasingly competitive international markets and how CEOs are responding

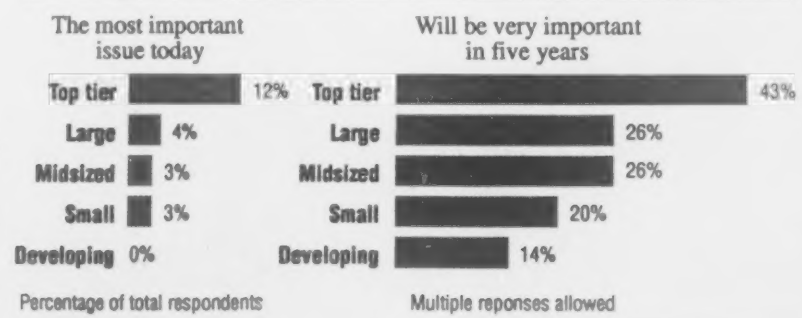
The globalization of electronics is reality. International trade drives the worldwide electronics industry, affecting virtually every key business decision made today. For the most part, chief executives of U.S. electronics companies are optimistic about the global business environment. They see strong growth prospects for their products overseas, as much of Western Europe consolidates and the Far East begins to mature.

To survive in the global market, the best defense is a strong offense. Increasingly, foreign sales are greater than domestic sales for many of the industry's leading companies, including IBM, Hewlett-Packard Co. and NCR Corp. According to the ELECTRONIC BUSINESS 200, a list of the top U.S. electronics companies, foreign sales have been growing as a percent of total sales throughout the late 1980s. In 1988, 31.5% of sales by the top 200 were overseas, up from 25% in 1987.

"One of the significant issues that American companies are having to face is the ability to manage their business when more than 50% of their market is outside the country," argues T. Kevin Dunnigan, chief executive of Thomas & Betts Corp., a connector manufacturer based in Bridgewater N.J. That means relinquishing control to regional headquarters and creating a more horizontally managed company.

CHART 1

FOREIGN COMPETITION: A GROWING CONCERN



A big-company issue

Foreign competition is seen as a critical issue primarily by big companies. Overall, international competition ranked seventh on a list of eight major concerns of executives surveyed. But for companies with annual sales of $300 million and above, international competition was ranked third, with 12% of the CEOs claiming it to be the most challenging issue they face (Chart 1).

Although foreign competition is intense now, many CEOs expect it to get worse in the future. "It used to be a three-and-a-half segment market — the U.S., Europe, Japan and the four Tigers [Hong Kong, South Korea, Singapore and Taiwan]. Now it's clearly a single market, and that has to be in the forefront of all CEOs' strategic thinking about how to survive in the 1990s," comments Stephen Kaufman, CEO of Arrow Electronics Inc., Melville, N.Y., an electronics distributor.

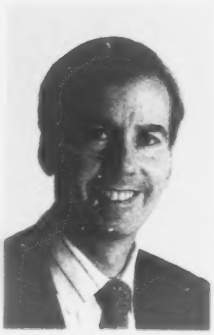
Indeed, foreign competition is driving many of the CEOs' strategic concerns. For instance, the need for better customer service, improved organizational excellence and higher quality often stem from growing international competition.

CEOs of American companies tell stories of how they cannot get domestic suppliers to provide parts that are of sufficiently high quality. Robert Shillman, CEO of Cognex Corp.,

CRITICAL ISSUES

Needham, Mass., says he was willing to pay a 20% premium to an American vendor for a telephone system, but ended up buying from a Japanese company because there was no U.S. vendor that could match the quality and service. "I'm very disappointed about that," says Shillman.

The same stories abound in printed circuit boards, components and semiconductor equipment. To compete, U.S. companies have no choice but to raise the standard of quality. Keithley Instruments Inc., a Cleveland-based manufacturer of semiconductor test equipment, had a quality culture imposed by its Japanese partner that has led to improved quality for all customers worldwide, says Thomas Brick, Keithley's chief executive. "When we send our instruments over to Japan, our trading partner will completely analyze them before he'll even think about promoting them," says Brick.



Thomas Bruggere, chairman and chief executive, Mentor Graphics

Improving quality for foreign customers is only part of the problem. The U.S. government's confused attitude about promoting exports is also a hindrance to global competitiveness, say CEOs. The Department of Commerce issues export licenses, but a number of other agencies have veto power. CEOs argue there is a real need for a more efficient mechanism in Washington to coordinate exports. "Our country is the most restrictive as far as [export] regulations are concerned," complains Safi Qureshey, chief executive of AST Research Inc., Irvine, Calif.

"You must have a government that provides a stable and reasonable climate within which to do business," says Keithley's Brick. His company recently contracted to sell a $1000 piece of hardware to a Hungarian company, but, because of the verification required by the U.S. government, Keithley decided it just wasn't

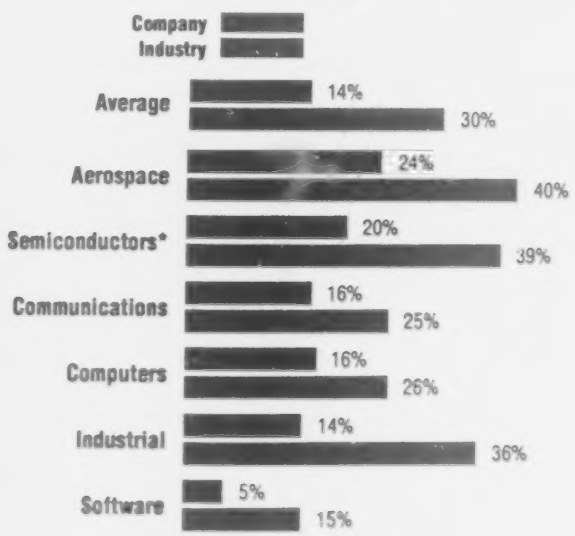
"WE HAVE TO HOLD ON TO U.S. TECHNOLOGY AND FIGURE OUT BETTER WAYS OF TAKING THAT TECHNOLOGY TO THE WORLD"

Mentor's Thomas Bruggere

CHART 2

PEAN NATIONALISM?

1992 will be bad for my company and even worse for my industry



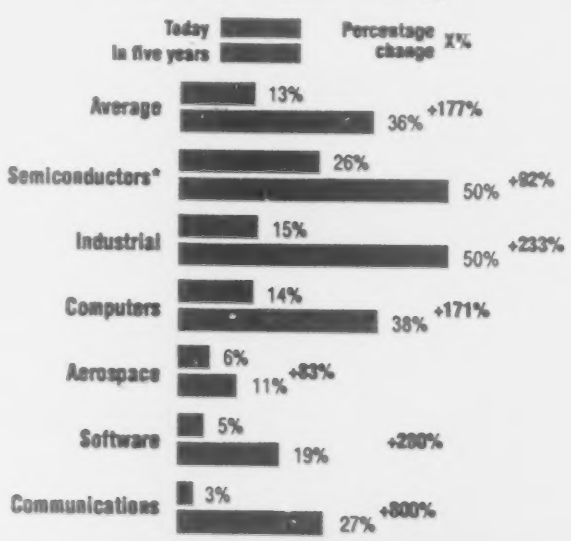
* Includes components and semiconductor equipment

Percentage of total respondents

CHART 3

MORE COMPETITION FROM OVERSEAS

My primary competitors are foreign



* Includes components and semiconductor equipment

Percentage of total respondents

worth the effort. The reason for all the red tape was that the package included a low-tech microprocessor, Brick says. Subsequently, a foreign competitor got the contract.

For Progress Software Inc., a $25 million Bedford, Mass., software developer, getting an export license "was a nightmare," says Chad Carpenter, the company's president. "The U.S. government was as confused as anybody."

Where will competition come from?

Western Europe will provide possibly the greatest immediate competitive threat as 1993 draws near, say CEOs. While 14% of companies expect the breakdown of intra-European trade barriers to have a negative impact on their companies' sales in Europe, 30% believe it will be negative for their industry. Chief executives fear the rise of European nationalism (Chart 2).

Craig Barrett, senior vice president at Intel Corp., Santa Clara, Calif., sees Europe 1992 as a "veiled threat." His concern is that as trade barriers fall between EC countries, "there may be tacit agreements among purchasing agents to buy European." It will make little difference what the government rules and regulations are if European buyers decide to patronize European companies. For instance, only European semiconductor makers are currently allowed to participate in the Jessi consortium — Europe's answer to Sematech — and there is discussion of increasing the European content of imported goods.

Thomas Sege, chairman and chief executive of Varian Associates Inc., Palo Alto, Calif., agrees: "I don't know about 'Fortress Europe,' but there may be a Europe with a picket fence around it — a selective tariff barrier."

One of the big question marks in the 1990s will be the development of Eastern Europe as a potential competitor. Most CEOs view the revolutionary changes taking place there as opportunities rather than as threats, but some see the long-term possibilities of competition.

While the Communist countries are expected to shift gradually toward market economies, they will not copy the U.S. free-enterprise model, speculates Griffith Resor, chief executive of MRS Technology Inc., a flat panel display company in Chelmsford, Mass. Instead, they may pick the Japanese model of strong government involvement, and in that way could prove formidable competitors, he says.

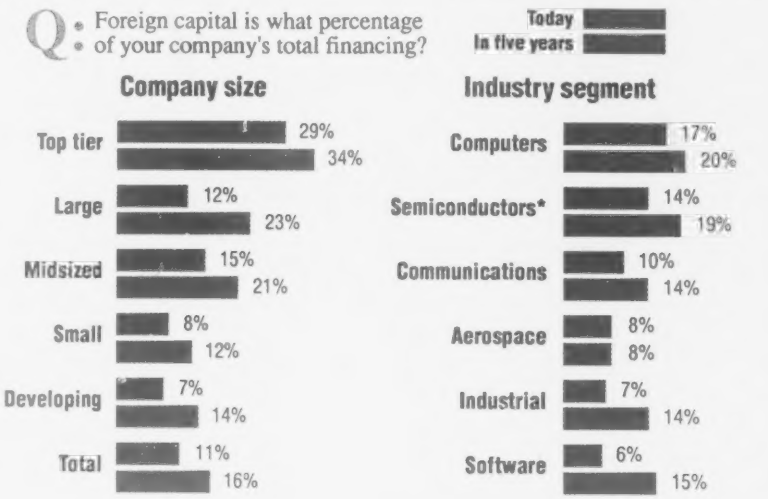
Whether Japanese or European, a growing number of U.S. electronics companies expect that in five years their primary competitors will be foreign. The worst-hit will be the industrial electronics and component makers who both expect 50% of their competition to come from overseas, up from today's 15% and 26%, respectively (Chart 3).

The biggest change, however, will occur in the voice and data communications market. CEOs expect an eightfold increase in foreign competition, from 3% today to 27% in five years. The reason is the general openness of the U.S. telecommunications market and the move toward international standards. Both will lead to an increasing number of overseas com-

CHART 4

OVERSEAS CAPITAL TO PLAY A BIGGER ROLE

Q: Foreign capital is what percentage of your company's total financing?

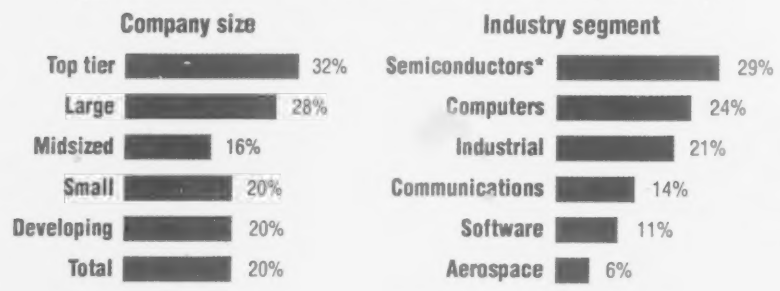


* Includes components and semiconductor equipment

CHART 5

M&A WITH FOREIGN COMPANIES TO INCREASE

Q: In the next five years, if consolidation does occur involving your company, will it be with a foreign company?



Percentage of total respondents

* Includes components and semiconductor equipment

panies selling into the United States in the future.

Somewhat surprisingly, the second-fastest-growing area in foreign competition will be software. Today, 5% of all software companies face a primary competitor from overseas, but in five years that will rise to 19%, say surveyed software vendors. This may be due, in part, to the growing Japanese focus on software. Other countries with software expertise, including several European countries, Singapore and India, are also expected to come on strong in the 1990s.

Foreign acquisitions

Acquisitions by and alliances with foreign companies will continue to play a key role in the U.S. electronics industry. Foreign capital currently accounts for 11% of total capital of the companies surveyed, but over the next five years that figure will increase by 45%, to 16%. The highest growth will come from developing companies, but large companies expect to account for the highest percentage of foreign capital (Chart 4).

Foreign acquisition will involve companies of all sizes. According to the survey, 88% of all companies with sales of $300 million and above expect to acquire other companies within the next five years, while 18% of the same group expect to be acquired. Thirty-two percent of these top tier companies expect to consolidate with a foreign company (Chart 5).

Even though competition is increasing, the cry for protectionism is largely absent. Most CEOs interviewed expressed the belief that the government's role should be to create an environment in which U.S. companies can compete more effectively against foreign companies. This includes tax incentives for capital investment, research and development spending and relaxing the antitrust laws to allow for consortia.

The government's role "should be focused on the opportunities where we can make a difference in the future, as opposed to protect a historically bad situation," says James Morgan, chief executive of Applied Materials Inc., a leading U.S. semiconductor equipment manufacturer in Santa Clara, Calif. That means government support for key technology sectors, including semiconductors and semiconductor manufacturing.

But there is also a need to protect indigenously created technology. In all, 24% of CEOs surveyed believe that this is a very important issue for the next five years. Similarly, 39% believe the government could do more to protect domestically developed technology.

"We have to hold on to U.S. technology and figure out better ways of taking that technology to the world," suggests Thomas Bruggere, chairman and chief executive of Mentor Graphics Corp., Beaverton, Ore. One proposal for keeping better U.S. control over indigenously created technology would be to create a disincentive system for technology transfer, he says.

According to the survey, most companies sell in Canada and Europe, while close to half sell in Japan and the Pacific Rim. Europe is expected to be the most important market in the next five years because of its size, followed by Japan, the Pacific Rim and Canada, in that order (Chart 6).

Japan continues to be the hardest market to penetrate. Thirty-one percent of all companies surveyed that have attempted to sell in Japan admit to having failed (Chart 7). The common complaint is the Japanese government's restrictions on imports, and "cultural" differences. But successful U.S. companies say it is a question of understanding the market and working with the system. "Whether you sell in Angola or Japan, you have to understand the rules of the game," notes one chief executive.

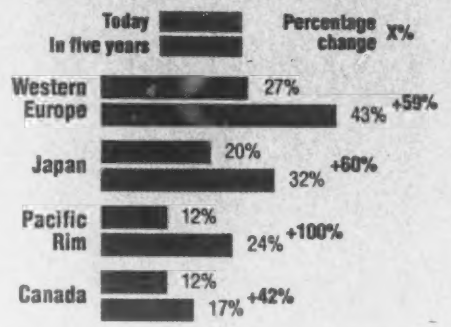
If Europe is the most important market, and Japan the toughest, then the most dynamic will be the Pacific Rim. Twelve percent of all CEOs say the region is very important to their strategy now, but in five years that figure will double, to 24%. While part of the strategic importance of the Pacific Rim is bolstering sales to the increasingly affluent economies of the region, the other advantage is cheap manufacturing.

A number of companies, mainly the larger ones, either have their own facility overseas or use third-party manufacturers. Many expect to build new facilities overseas in the next five years. After the U.S., Europe is the most popular location, followed by the Pacific Rim. Fifty-one percent of top-tier companies will build new facilities in Europe. Location in Europe is planned mainly to gain proximity to the market, while building in the Pacific Rim is driven by low labor costs. □

CHART 6

STRONG FOREIGN SALES

Q: Which of the following geographic areas are very important to your business strategy?

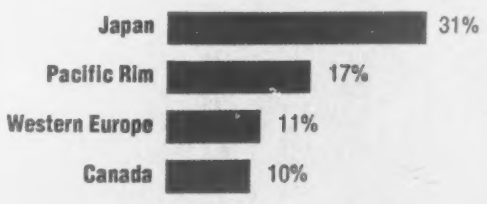


Percentage of total respondents, multiple responses allowed

CHART 7

DIFFICULTIES IN JAPAN

Q: Has your company been unsuccessful in its attempts to sell products into any of the following markets?



Percentage of total respondents

The changing structure of capital formation

Capital is the dominant issue today. Where it comes from, how much it costs and how it will be used are shaping the industry of tomorrow

Capital tops the list of immediate concerns for the chief executives in the U.S. electronics industry, according to the results of the ELECTRONIC BUSINESS/Ernst & Young CEO survey. Twenty-five percent of the 750-plus chief executives surveyed named capital availability as their most pressing problem today. The issue came up repeatedly in all the interviews and round-table discussions that followed the survey.

Two issues concerning capital are particularly frustrating for CEOs. First, the relative cost of capital is high in the United States. The U.S. prime lending rate is around 10%, while Japan's hovers below 5%. The U.S. government is largely responsible for the high interest rates, say CEOs. A concerted effort is needed to reduce the budget deficit below the 1989 level of $152 billion, which will help relieve pressure on interest rates.

The second concern is the short-term stranglehold that Wall Street has on public companies and that private investors — venture capitalists, especially — tend to put on private companies. CEOs complain that they must compromise long-term strategic planning in order to show a profit for the next quarter. "Unless we can fix it, get more of a long-term orientation, it will portend serious problems for companies," warns Edward Esber, CEO of Ashton-Tate, Torrance, Calif.

Many executives share Esber's view. They believe that the short-term focus is creating an industrial structure in the United States that presages a continued deterioration in international competitiveness. These CEOs point to the continuing focus of high-technology companies solely on core businesses as a symptom of this short-term mentality. Companies often sell unprofitable divisions to satisfy short-term financial performance criteria, even though these divisions might hold the possibility of long-term viability.

One suggestion for ways to help the short-term/long-term situation is to reinstate the capital gains tax differential for money invested over the long haul. "Without the incentive of long-term capital gains in the early '80s or late '70s, there wouldn't have been the pool of venture capital that started my company," argues Robert Shillman, chief executive of Cognex Corp., Needham, Mass.

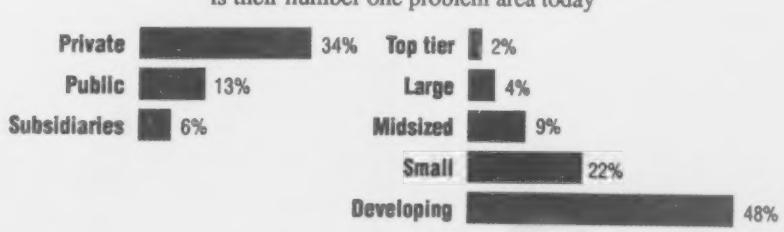
The Tax Reform Act of 1986 made the top income tax rate equal to the capital gains tax rate —thus removing an important incentive to take entrepreneurial risks, many CEOs argue. A reinstatement of the differential is important, many executives say, but it should be legislated only for long-term investments, to minimize short-term speculation.

While most CEOs rail against the short-term mentality of narrow-minded investors, capital availability is most acute for start-ups. Forty-eight percent of all companies with

CHART 1

SMALL PRIVATE COMPANIES' CAPITAL WOES

Percentage of total respondents saying capital availability is their number one problem area today



sales under $5 million cite capital availability as their top problem. The concern drops off dramatically as the company size increases. But because developing companies account for 30% of all companies surveyed, and a substantial percentage of the industry at large, capital availability is viewed by many as a central issue for the industry's future health (Chart 1).

Gabriel Fusco, Chairman and CEO of Sequoia Systems

Despite their distrust of Wall Street, most CEOs expect to go to the public markets for capital in the near future. The greatest increase will be among developing companies, which expect 23% of their total funding to come from public markets by 1995, up sharply from 4% today (Chart 2). Over the next five years, 46% of all developing companies expect to go to the public markets for either an initial public offering or a secondary offering.

"The advantages of being public in the United States, unfortunately, do outweigh the disadvantages," insists Gabriel Fusco, chairman and chief executive of Sequoia Systems Inc., in Marlborough, Mass., a manufacturer of on-line transaction processing systems. For many start-ups, the initial public offering is a rite of passage and earns the company much-needed respect. Having a stock symbol next to your name makes the difference when trying to sell a million-dollar system, says Fusco.

But going public is not as easy as CEOs may expect. The cost of funds is still high and investor sentiment toward high technology is low, so the dream of an IPO might not materialize for many developing companies.

A slowdown in start-ups

If the IPO market is sluggish, the flow of seed money is downright glacial. The consequences for the electronics industry are serious. According to the survey, the number of companies formed between the early 1960s and 1984 showed a steady rise, but over the past five years the rate has dropped dramatically (Chart 3).

From a high in 1984 of 65 new companies, the number of start-ups among surveyed companies dropped to only 18 in 1988. While there may be some bias in the sample toward older, established companies, there is no mistaking the general downward trend. The decline is evident in all market segments, from aerospace and defense to software.

What's causing the slowdown? The root of the problem lies with capital funding. The recent trend of high interest rates, slower economic growth and slower growth in venture funding bodes ill for the industry's new blood. A dramatic slowdown in start-ups is predicted by the survey unless new sources of funds are found.

Contributing to the slowdown is the sluggish growth of research and development spending since the early 1980s. According to Data Resources Inc., an economic forecasting firm in Lexington, Mass., total industry R&D spending growth has dropped from a 10-year average of 12.7%, be-

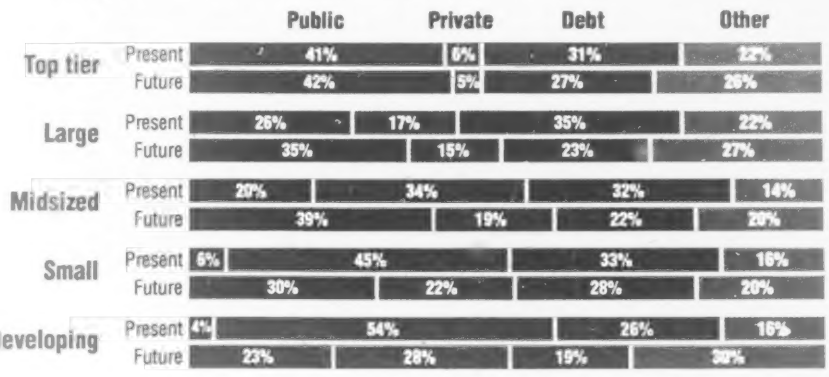
"THE ADVANTAGES OF BEING PUBLIC IN THE UNITED STATES, UNFORTUNATELY, DO OUTWEIGH THE DISADVANTAGES"

Sequoia System's Gabriel Fusco

CHART 2

PRESENT AND FUTURE SOURCES OF FUNDING

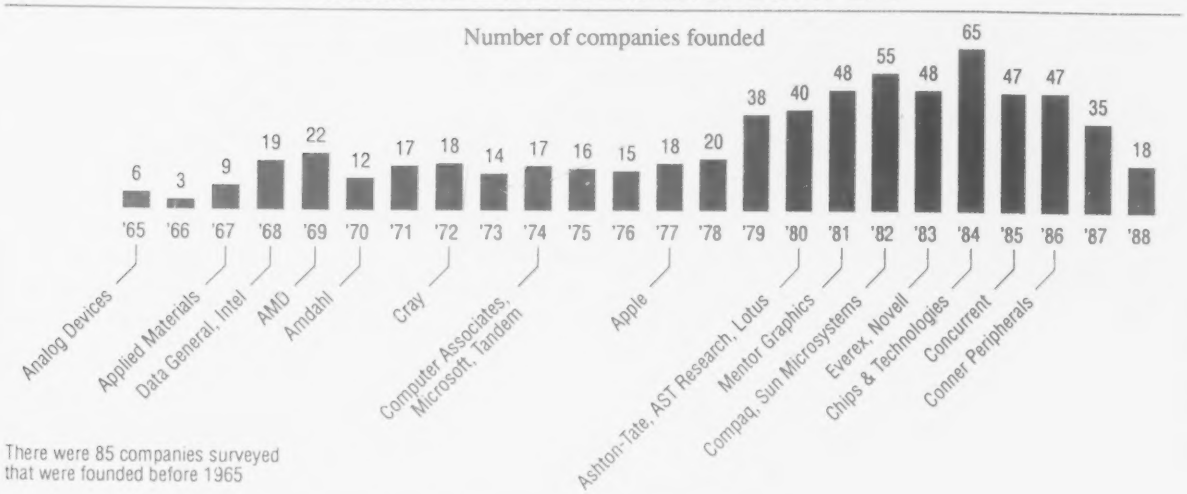
Q: Where does your company's financing come from currently? Where will it come from five years from now?



Percentage of total funding

CHART 3

DRAMATIC DROP IN NUMBER OF START-UPS



There were 85 companies surveyed that were founded before 1965

tween 1975 and 1985, to just 4.7% in 1988. According to those companies surveyed, R&D spending will grow from 9.5% of sales today to 9.8% in five years.

The National Science Foundation reported in January that total U.S. R&D spending adjusted for inflation actually declined by 0.9% between 1988 and 1989. Some analysts argue that as R&D spending slows, so will the development of new products and new companies.

New sources of funds

If conventional venture capitalists won't back new start-ups, entrepreneurs will be forced to go elsewhere. The most likely direction is to look for a strategic alliance with a larger company. Such a strategy serves both participants well: the start-up gets its money, and the large company gets advanced technology.

Most strategic alliances have been in the form of marketing agreements, but in the next five years electronics companies expect to see significant growth in technology alliances. Forty-five percent of the CEOs surveyed said their companies currently license technology; in five years, that number will grow to 54%.

Another option for the high-growth company in search of funds is to be acquired. A startling 54% of all the companies surveyed expect to be acquired within the next five years (Chart 4). While 67% of all developing companies expect to be bought out, some 18% of all companies with sales of $300 million and above also expect to be acquired. In cases where consolidation will take place, 20% of the companies surveyed expect that consolidation to involve a foreign company.

More and more often, CEOs are looking overseas for new sources of capital. According to the survey, foreign capital will see a rise in popularity over the next few years. From an average of 11% today, CEOs expect foreign funds to account for 16% of their total financing needs within the next five years.

For computer and peripherals companies, 20% of all funding will come from overseas, up from 17% today. Software companies expect the most dramatic rise in foreign dependence. Today, software companies get only 6% of their funding from overseas, but by 1995 that figure is expected to rise to 15%.

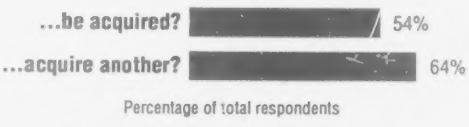
The influx of foreign capital will bring with it a change in strategic focus, according to Peter Johnson, president of Eltech Electronics Inc., a contract manufacturer with facilities in Singapore and North Billerica, Mass. "As Japanese companies and other companies take larger positions in U.S. companies, there will be a different set of ground rules as to what is considered good performance."

Foreign ownership — especially Far Eastern ownership — means more of a focus on a company's long-term market positioning. For many U.S. CEOs, that would be a welcome change. □

CHART 4

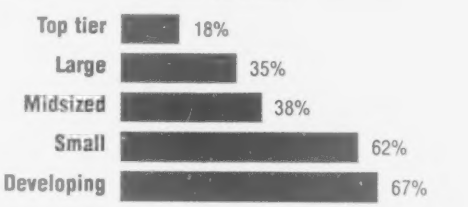
ACQUISITIONS INTENSIFY

Q • In the next five years, • will your company...



Percentage of total respondents

Not all companies being acquired will be small



Percentage of respondents saying they will be acquired

Shift in focus for strategic alliances

Partnering is on the upswing for technology, product development and manufacturing, but not all alliances are growing in popularity

The overwhelming majority of CEOs believe that strategic alliances will become more important for their corporate strategies over the next five years. Manufacturing and technology alliances will grow markedly but marketing agreements are likely to decline, say chief executives.

CEOs expect manufacturing alliances to grow by 33% and technology alliances to post a 20% growth during the next five years. Research and equity alliances will also see significant gains in the next five years. Marketing agreements, the long-standing favorite in joint ventures, will decline by 9%, say the chief executives surveyed (Chart 1).

The decline in marketing agreements and growth in other types of alliances point to a structural change in corporate relationships for the 1990s. Many companies are hoping to strengthen technology and product development ties, while weakening product distribution ties.

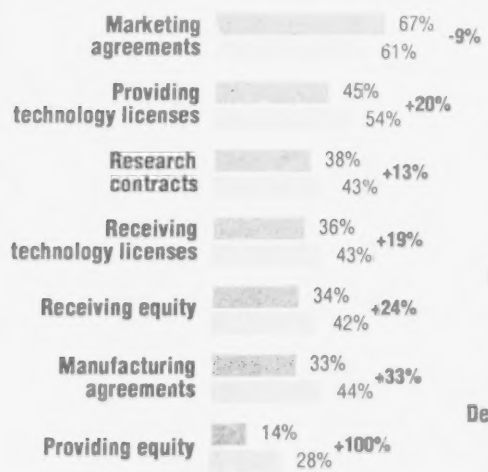
Companies with annual sales of $300 million or more will experience the sharpest decline in marketing alliances in the next five years. Software companies are most likely to reduce reliance on marketing agreements, while computer and peripherals makers say they expect to increase marketing agreements (Chart 1).

What's causing the shift away from marketing agreements? As globalization increases, U.S. companies expect to gain more expertise in foreign markets and are hoping to take back marketing control. For instance, a relationship with a European distributor might be ideal for the short term, but as the U.S. partner gains confidence and sets up its own European operation, the distribution relationship could be phased out.

CHART 1

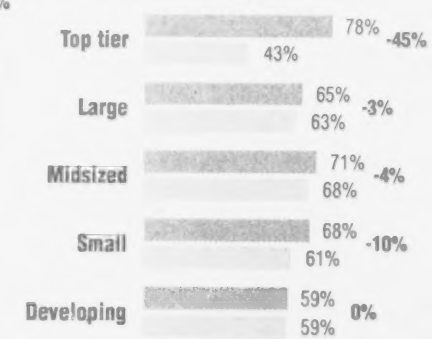
MOST TYPES OF ALLIANCES INCREASE IN '90S

Q: What kinds of alliances does your company have now or will it have in five years?


Today
In five years
Percentage change X%
Marketing agreements 67% 61% -9%
Providing technology licenses 45% 54% +20%
Research contracts 38% 43% +13%
Receiving technology licenses 36% 43% +19%
Receiving equity 34% 42% +24%
Manufacturing agreements 33% 44% +33%
Providing equity 14% 28% +100%

Percentage of total respondents

Top tier companies are shying away from marketing agreements:



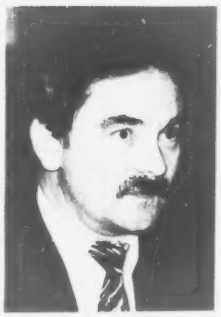
Percentage of respondents that have or will have marketing agreements

Cooperative R&D

Some CEOs argue that U.S. companies should attempt to cooperate more. "The industry has to work together to save itself" against foreign competition, says James Morgan, chief executive of Applied Materials Inc., Santa Clara, Calif., referring to the U.S. semiconductor equipment industry, which largely comprises small companies. That means more mergers and acqui-

sitions, and more cooperative research and development.

According to the survey, small companies expect to rely more heavily on technology exchanges over the next five years, while large companies will back off slightly (Chart 2).



Douglas Bartek, vice president and general manager, VLSI Technology

Evolving standards are one reason for the shift toward more technology alliances. The fight over a generic Unix language has resulted in some interesting bedfellows — Digital Equipment Corp., Hewlett-Packard Co., IBM and others banded together to form the Open Software Foundation Inc. — and the development of an extended industry standard architecture (EISA) in the microcomputer market pits a gang of nine PC makers against IBM.

In aerospace and defense electronics the number of companies providing technology licenses will increase by 62% over the next five years, as a shrinking U.S. defense budget puts pressure on companies to turn to commercial markets and expand overseas. "I think we'll see more and more involvement in international contracts," says Robert Schultz, chief executive of GM Hughes Electronics Corp., "and by the same token, foreign companies will be more involved in this country." GM Hughes and other prime contractors are forming alliances with technology leaders in foreign defense markets in order to go after new business.

The high cost of developing advanced technology is a serious problem for CEOs, especially in the semiconductor business. Developing the next generation of IC process technology means spending upward of half a billion dollars. Technology partnerships are viewed as insurance policies that protect each partner from making poor technology decisions; examples include Texas Instruments Inc.'s deal with Hitachi Ltd. and Motorola Inc.'s relationship with Toshiba Corp. for dynamic RAM technology.

But partnering takes work. "One of the key aspects of any successful partnership is a continued mutual dependence on each other so that one partner doesn't progressively become the dominant player," warns Douglas Bartek, vice president and general manager of one of VLSI Technology Inc.'s divisions. VLSI exchanges ASIC design tools for manufacturing expertise and process technology with Hitachi and N.V. Philips, says Bartek. The best way to avoid problems is to make sure the partnership is well defined at the outset, say many chief executives.

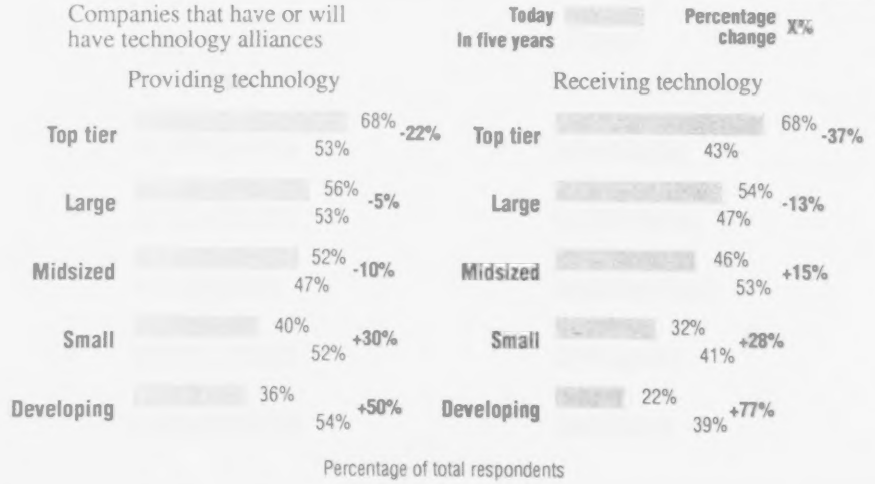
The cost of R&D is a major driver for technology alliances. In total, R&D spending as a percentage of sales will increase by only 3% over the next five years from 9.5% today. By 1995, according to the survey, R&D spending will account for 9.8% of sales. In three market segments — software, industrial electronics and computers and peripherals — R&D spending as a percent of sales is expected to decline. While some of the

"ONE OF THE KEY ASPECTS OF ANY SUCCESSFUL PARTNERSHIP IS A CONTINUED MUTUAL DEPENDENCE ON EACH OTHER SO THAT ONE PARTNER DOESN'T PROGRESSIVELY BECOME THE DOMINANT PLAYER"

VLSI's Douglas Bartek

CHART 2

TECHNOLOGY ALLIANCES FAVORED BY SMALL COMPANIES



drop can be traced to sales increasing faster than R&D, there will also be a shift away from in-house R&D toward cooperative agreements, say surveyed CEOs.

Closer relationships can reduce R&D costs. For instance, at AST Research Inc., Irvine, Calif., engineering and development spending was just 3.7% of sales in fiscal year 1989, well below the 24% average for the other computer and peripherals makers surveyed. "If we were developing everything ourselves, the R&D percentage of sales would jump up to eight, nine or 10 percent," says Safi Qureshey, chief executive of AST. His company has formal and informal developmental relationships with Microsoft Corp., Intel Corp. and Novell Inc., to name a few.

Global manufacturing

The increasing interest in manufacturing alliances is driven by the need to cut costs. Component makers generally lead in the number of manufacturing alliances, now and in predictions for the future. The mushrooming of fabless semiconductor startups, which sprouted in the mid-1980s, is just one example of the trend toward contract manufacturing.

Quality plays a role in the overall trend toward manufacturing alliances, too. As companies face the need for higher quality, they reduce the number of their suppliers. Many companies have established closer supplier alliances as a means of ensuring a steady stream of products that do not require inspection or testing. The paring-down will continue well into the 1990s, say CEOs.

Equity role to grow

For some companies, particularly smaller firms, an equity stake is a financial necessity and helps to create a sense of commitment by the partner. For others, mainly larger companies, equity often signals loss of control. "Companies that can operate as two independent firms, who come together because there's a mutual business interest, are stronger alliances than those that are bought by money," argues Winston Hindle, senior vice president at Digital Equipment Corp.

Whatever the preference today, in the 1990s equity will play a bigger role in strategic alliances for companies of all sizes, say those CEOs surveyed. Surprisingly, the biggest equity shakeup will be at the top end of the revenue scale. Of companies with sales between $100 million and $300 million, the number that expect to spend money on equity funding deals will nearly double over the next five years. At the same time, 76% more companies with annual sales of $300 million and above will be on the receiving end of equity deals (Chart 3).

Foreign equity will play an even bigger role in alliances in the next few years. Currently, an average of 3% of the total financing for those companies surveyed comes from foreign alliances, but that figure is expected to double, to 6%, by 1995.

Likewise, foreign capital — including equity, licensing, debt and alliances — will increase from 11% of total capital needs today to 16% in five years, according to the survey (Chart 4). The biggest change in foreign dependence will come from developing companies which will see a 100% increase in foreign capital reliance. Also, companies with sales between $100 million and $300 million expect to increase their reliance on foreign capital as a percent of total capital by 92%, from 12% today to 23% by 1995. □

CHART 4

INCREASE IN FOREIGN CAPITAL

Q: Foreign capital accounts for what percentage of your company's financing?

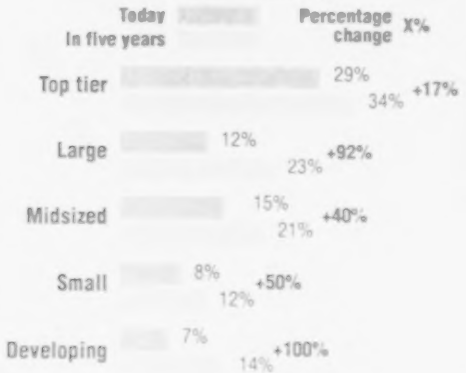
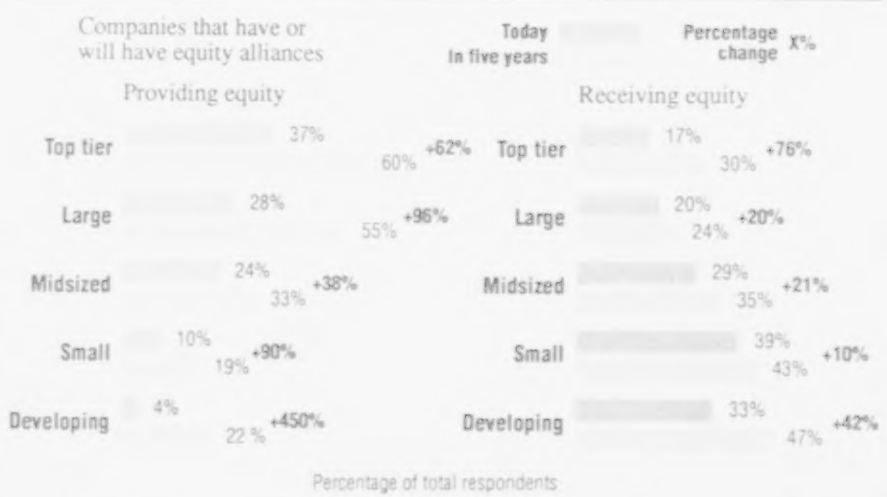


CHART 3

EQUITY COMES FROM BIG COMPANIES



CRITICAL ISSUES

Electronics and government: A wary association

Government may become more of a friend to industry as both battle foreign competition and try to build a stronger business environment

It's like the weather. Executives in the electronics industry like to complain about the U.S. government. Washington is often ill-informed about electronics, and legislation is frequently counterproductive to the industry, executives say. "The greatest challenge we have is not dealing with foreign competition; I think it's our own government," says one frustrated CEO, echoing the sentiments of many of his peers.

Several electronics trade associations intensively lobby Capitol Hill, but there is a sense that the industry seldom presents a unified front. Congressional sympathy is not high for an industry that is not clear in its political goals. A case in point is the recent failed attempt to form the U.S. Memories consortium. Supporters could not generate enough corporate funding for the dynamic RAM production project, even after having spent months in Washington convincing Congress of its importance. Still, there is a growing awareness among top executives that their views are needed in Washington.

"I think we have an absolute obligation to take a much more proactive stance with government," states F. Gordon Benhard, president and chief executive of Elpac Electronics Inc., Santa Ana, Calif. "If we fail as an industry to do that, then we're going to have some extremely difficult times in the decades to come," he adds. The survey and interviews indicate that executives believe their success in the decade ahead will require closer cooperation between the electronics industry and the federal government.

But what exactly does electronics want from the federal government? At the top of the list, surveyed CEOs believe the government should provide better financial incentives, primarily to lower capital and R&D costs (Chart 1). Capital-intensive companies in industrial electronics, computer and semiconductor markets have the greatest need for such incentives, according to the survey. Many chief executives insist that a new investment tax credit, better research and development tax breaks and low-cost, government-sponsored loans are in order.

CHART 1

HOW COMPANIES RANK GOVERNMENT ACTIONS

Q: Rate the desirability of the following government actions on your company.

		Ranking					
		Computers	Software	Communications	Semiconductors	Aerospace	Industrial
Provide financial incentives	42%	1	2	1	1	3	1
Protect proprietary domestic technology	39%	2	1	4	2	4	2
Act against unfair trade practices	31%	3	6	2	3	7	3
Ease regulation	29%	4	5	3	6	1	4
Fund research projects	27%	5	4	5	5	2	6
Support academic research	25%	6	3	7	4	5	7
Enact trade agreements	19%	7	8	6	7	8	5
Promote technology exchange	16%	8	7	8	8	6	8

Percentage of total respondents; multiple responses allowed

CRITICAL ISSUES

One reason companies build facilities overseas is that foreign governments provide more investment incentives than the U.S. government. That has implications for U.S. employment and industry growth. Over a quarter of all executives surveyed say that government incentives are the most advantageous factor for building both in the Far East and in Europe (Chart 2).

Winston Hindle, senior vice president of corporate operations, Digital Equipment

Stronger legislation for protecting proprietary domestic technology is also a high priority for CEOs, especially those at software companies. While legislation to protect intellectual property in the U.S. has made great strides in the 1980s, protecting that property in overseas markets remains a major problem. Software piracy in particular is a concern in many Asian markets where enforcement of copyright laws is lax. The feeling by U.S. companies is that legal recourse is not enough and should be enhanced by better U.S. government protection.

Among aerospace and defense electronics companies the top concern is easing government regulations. One example would be to reduce the paperwork involved in selling to the Department of Defense. For instance, the introduction of the computer-aided acquisition and logistics support (CALS) initiative will eventually simplify weapons-systems documentation and cut costs. There is also a trend toward buying more off-the-shelf commercial systems.

Defense electronics companies also want to see more government funding of research projects. But with cuts in defense budgets over the next few years all but certain, the Defense Advanced Research Projects Agency (DARPA) and other government-funded agencies will have to reduce their spending in the 1990s.

Increased government funding for academic research is a high priority for software companies. That includes high-level language-development projects and other basic research. "I think there has got to be some awareness, sooner or later, that the very basis of our technological leadership will be threatened in the software arena [unless more government support is given]," argues Raymond Noorda, CEO and president of Novell Inc., Provo, Utah.

Stay at arm's length

Even though government has an important role to play in electronics, many chief executives want the government to stay at arm's length. The government would be wise to face up to its own economic problems and focus on broad international issues, say CEOs. While fear of a recession is the top-ranked economic concern for companies, the federal budget deficit is also a major concern (Chart 3). A growing national debt keeps pressure on interest rates and makes U.S. capital more expensive.

Most CEOs do not want the government to erect barriers around their markets. The government's role is not to protect the semiconductor industry, suggests Charles D'Ambrosia, president of Applied Microsystems Corp., Redmond, Wash., "but to deal with the free-trade system on a worldwide basis."

Even though international trade is most important to large companies, especially component and semiconductor equipment makers, nearly a third of all companies surveyed think that the government should get tough with unfair trading practices by foreign competitors. That includes a tougher stance on dumping and retaliation against closed markets.

The government should negotiate trade agreements at the highest levels, industry executives say, beginning with Japan. Western Europe comes in second, followed by the Pacific Rim countries, according to the survey (Chart 4). Half of all companies surveyed believe that their success in penetrating Japan depends on the government's ability to negoti-

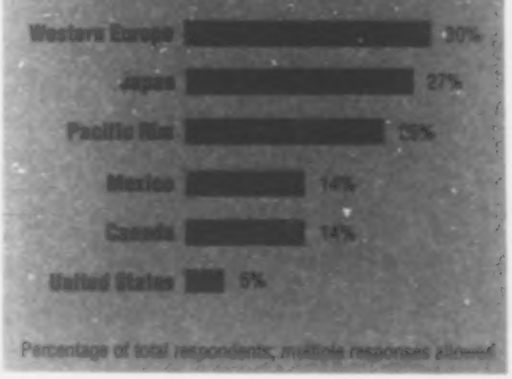
"THE UNITED STATES GOVERNMENT HAS PLACED EXPORT CONTROLS ON US, WHICH PUTS US AT A COMPETITIVE DISADVANTAGE ON A GLOBAL SCALE"

DEC's Winston Hindle

CHART 2

GOVERNMENT SUPPORT

Government support is the most important reason for manufacturing in the following region or country:



Percentage of total respondents; multiple responses allowed

SURVEYED CEOS BELIEVE THE GOVERNMENT SHOULD PROVIDE BETTER FINANCIAL INCENTIVES, PRIMARILY TO LOWER CAPITAL AND RESEARCH COSTS

ate tougher trade agreements.

But prying open foreign markets is only one side of the problem. The other side is to do a better job of promoting U.S. exports. "I think that the United States government doesn't yet perceive that technology is, in fact, global, and consequently it has placed export controls on us and on others who have high-technology products, which puts us at a competitive disadvantage on a global scale," says Winston Hindle, senior vice president of corporate operations at Digital Equipment Corp.

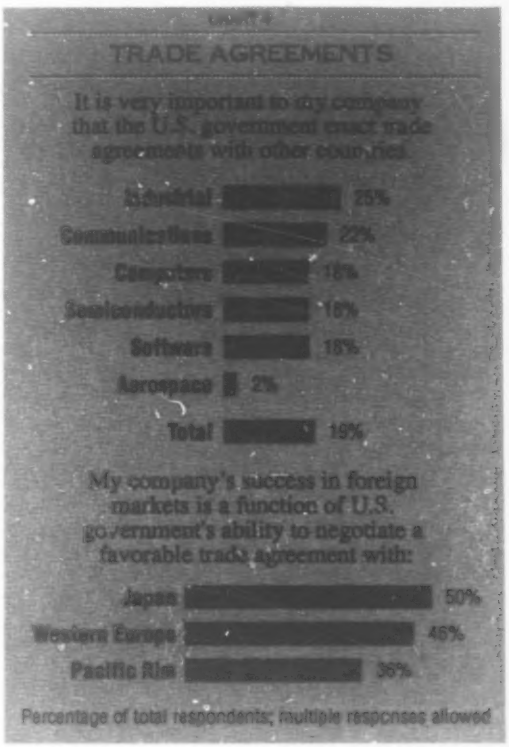
The result is that U.S. companies seeking export licenses are forced to spend time and money justifying the export of low-technology products. For many, it's just not worth the effort. In addition, a foreign customer may end up waiting so long for a U.S. product that they ultimately turn to other suppliers. "I think the government is hindering us," says Thomas Brick, chief executive of Keithley Instruments Inc., Cleveland, Ohio.

Part of the problem is that there are too many governmental cooks. Export licensing is the Commerce Department's terrain, but the State Department, the Department of Defense and the Department of Energy all have veto power. Electronics executives want a single body in Washington that can make the decisions and grant export licenses.

"It is still a joke that the day the 80286 [an Intel Corp. microprocessor,] was liberalized by the Department of Commerce, the Secretary of Defense went on TV and said that exporting 286s was comparable to exporting B-2 technology. But the thing is, if you don't get a chance to export those 286s, there won't be any money for B-2s," says Safi Qureshey, chief executive of AST Research Inc., Irvine, Calif.

A number of executives point to the need for a government initiative to revive the U.S. electronics industry, especially now that the defense industry is heading south. Since the '60s and '70s — when technology basically started in the military, went to the commercial-industrial market and then to the consumer market — the whole process has been reversed, argues T. Kevin Dunnigan, CEO of Thomas & Betts Corp., Bridgewater, N.J. "If you believe that electronics is a strategic industry, then we need a new vision [for consumer electronics]."

The government should start by backing a high-definition television program, say some executives. But more is needed. Better patent protection and access to cross-license technology from Japan are two examples cited by James Treybig, CEO of Tandem Computers Inc., Cupertino, Calif. "There are patents that Japan won't cross-license, there's the cost of capital, there are lots of things that need to be done," he adds. □


TRADE AGREEMENTS
It is very important to my company that the U.S. government enact trade agreements with other countries.
Industrial 25%
Communications 22%
Computers 18%
Semiconductors 18%
Software 18%
Aerospace 2%
Total 19%
My company's success in foreign markets is a function of U.S. government's ability to negotiate a favorable trade agreement with:
Japan 50%
Western Europe 46%
Pacific Rim 36%
Percentage of total respondents; multiple responses allowed

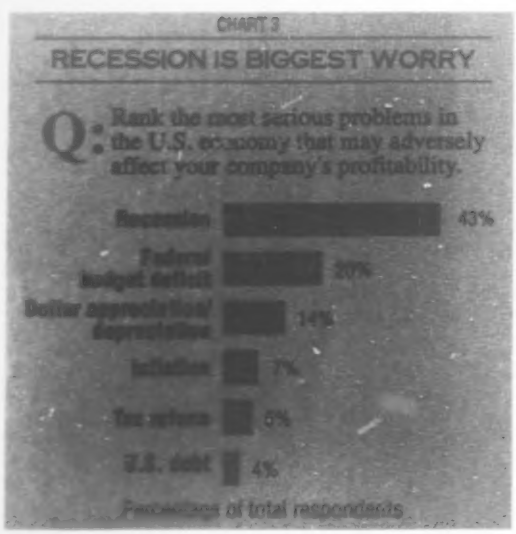


CHART 3
RECESSION IS BIGGEST WORRY
Q: Rank the most serious problems in the U.S. economy that may adversely affect your company's profitability.
Recession 43%
Federal budget deficit 20%
Dollar appreciation/ depreciation 14%
Inflation 7%
Tax reform 6%
U.S. debt 4%
Percentage of total respondents

What the leaders think

ELECTRONIC BUSINESS senior editor Bruce Rayner and Ernst & Young partners conducted a series of one-on-one interviews with leading electronics CEOs about the challenges their companies face. What follows are question-and-answer excerpts from these interviews.

Compaq keeps an R&D lead

Rod Canion, chief executive, Compaq Computer Corp., Houston, Texas. Compaq has grown its personal computer business through a strategy of lightning-fast time-to-market and top-notch quality.

Q: Where will the fastest growth be in the 1990s?

Canion: We still think that, at least for the next few years, the growth rate in Europe, combined with its size, will be the major factor of [Compaq's] growth, and then probably beyond that — in the four- to eight-year time frame — the Far East will become a bigger factor.

Rod Canion, Compaq Computer

We have a good position everywhere but Japan, and we're likely to enter Japan at some point in the next decade. It could be [within the next two or three years] or it could be longer. What we're going to do is study the market, come up with a game plan for how to be effective, rather than just sort of leap onshore and see what it's like.

Q: Would Compaq tie up with a Japanese company?

Canion: Not necessarily, no. We're not ruling anything out at this stage, but the factors I've talked about are very general in nature. Depending upon what we conclude is the right approach, my guess is it's fairly unlikely that we would [tie up with a Japanese company], just based on our experience with trying to work with companies.

It's very hard to find a company that is compatible enough to really make it effective. Joining up with a company is a good, quick way of getting a fast start, but the downside typically is what happens in three to five years. And we will tend to be looking at the long term as opposed to the short term.

Q: Your R&D spending is between 4% and 5% of sales. Is that sufficient for the 1990s?

Canion: I think we are in the right range. We may see it evolve upwards another point or something, but we don't anticipate it doubling at all. I think where that question comes from is looking at our competition — they spend a much higher percentage on R&D.

I think, if you look at our product flow, it's obviously not a limiting factor in our ability to create new products. It has to do more with our efficiency and our ability to deliver products quickly. So you don't have to spend as much money on each product. You can get on to the next one much quicker. And that results in a lot of very positive benefits for the company, one of which is a lower percentage of R&D spending.

And that's not the most important, by the way. The most important one is the ability to get out in front of and maintain [the lead over] many of our competitors, from a technology-cycle standpoint.

GM Hughes cuts back defense

Robert Schultz, chief executive, GM Hughes Electronics Corp., Detroit, Mich. GM HE, a GM Corp. subsidiary, is the parent of Hughes Aircraft and Delco Electronics.

Q: What are some of the effects of the defense cutbacks on GM Hughes?

Robert Schultz, GM Hughes Electronics

Schultz: The defense side of the business, I think, is clearly going to be impacted by the events of the day. But what that's going to result in is almost impossible to say until the smoke clears a little bit here and we can see better into the future. Defense spending itself is bound to decline unless there is a radical turnaround.

At the same time, I think the opportunities for utilizing [defense] electronics technology have great potential in the commercial markets. For example, we were awarded a very major air-traffic-system contract in Canada. That type of thing is going on all over the world: certain commercial airline businesses, the communications and satellite business, intelligent highway programs, environmental monitoring.

Q: Will defense continue to decline as a percentage of your overall business?

Schultz: I think clearly it will, as a percentage. In fact, the companies that can't leverage their technology into useful commercial products are going to suffer.

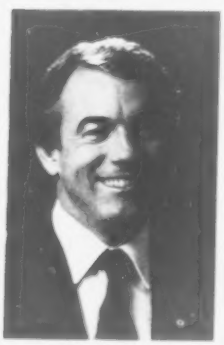
I think there's going to be a lot of fallout. Primarily among companies that are very specialized and, as a result, may not have the flexibility to shift their technology into some of these other areas. I think it'll primarily be at the second tier. But I wouldn't say that the primes won't be affected, because I think they will be. I just think there's not going to be that many new airplanes, that many major missile systems.

Q: What's the recipe for success for the defense electronics company of the future?

Schultz: It's a combination of strategic alliances. I think we'll see more and more involvement in international contracts. And by the same token, [foreign companies] are going to be more and more involved in this country. I don't think U.S. companies are going to go to Europe and capture major contracts by themselves. I think it's going to be more in the technology sharing and manufacturing capabilities. So I think that the joint ventures, whatever form they take, will be increasingly important, and I think that that's going to be a way of life.

Applied wants cooperation

James Morgan, chief executive, Applied Materials Inc., Santa Clara, Calif. Applied Materials is a leading U.S. maker of semiconductor production equipment.



James Morgan, Applied Materials

Q: What's the role of the U.S. government in electronics?

Morgan: It should be focused on the opportunities where we can make a difference in the future, as opposed to protecting a historically bad situation. [But the government's role] should be transient. You've got to get cooperation or you're not going to be successful. You're not going to be able to compete.

Q: Is Sematech the answer?

Morgan: It's a big help, but everybody gets the idea that it's the solution. Sematech only has $200 million for R&D. We'll spend close to $100 million ourselves, and we don't have enough. It would help if [the government would] give us $50 [million] or $100 million and we'd spend it right.

In the U.S. you have a real problem with the antitrust [laws]. We only look at the U.S. competitors for evaluation, and that's dumb, because almost none of us [have] our primary competitors in the United States. So if you don't look at the antitrust issue on a broad basis, then you're not getting a realistic look at the market.

Intel focuses on the customer

Craig Barrett, executive vice president, Intel Corp., Santa Clara, Calif. Intel, one of the top 10 semiconductor companies in the world. Barrett is the heir apparent to CEO Andrew Grove.

Q: What are the solutions to maintaining a viable semiconductor equipment industry?

Craig Barrett, Intel

Barrett: Sematech's a start. What Sematech can do is foster standards. It can help design, debug, evaluate, proliferate equipment to leverage the whole industry. Sematech's job is to effectively nurture one or two strong players in lithography, furnaces, implant, plasma etch, metal sputtering — those five areas comprise 80% of the capital equipment.

But a lot of it is going to be up to us to buy [from] and support American companies. The problem with the commitment [to buy American] is that it wavers substantially when the vendor doesn't make it, you miss a generation of technology. We were a year late in one of our recent generations of technology because we were on a lithography vendor who didn't make it.

Q: Why is it important to buy from American vendors?

Barrett: I'll tell you why. I was at a SEMI [Semiconductor Equipment and Materials Institute] meeting in Japan and the representative from Nikon stood up and said: "When appropriate, we may even tell our foreign customers about our new equipment." I can't say it any better. "When appropriate," we may hear about their new technology at the same time their Japanese customers hear about their new technology.

A public statement like that to a bunch of U.S. and Japanese folks says it pretty clearly. Nikon happens to be our supplier, and it's nice to know that "when appropriate" they might even tell us about the next generation. I'd rather have someone who's local and committed and, "when appropriate," they might even tell the Japanese about their next generation.

Q: There's been a lot of attention at Intel on manufacturing. Is there much more to be done in that area?

Barrett: We've made a lot of progress. But until you get to 100% yield, there's always ground to play with there. I say that kind of jokingly, but let me give you a simple analogy. If we're projecting out into the second half of

the decade, we'll be making chips that are one square inch, with 25 [million] to 50 million transistors. Do even the most simple-minded analysis on what defect density is necessary to get any yield on those things, and the number that pops into your head very quickly is zero defect density. A hundred percent yield. So until you get to that, there's a lot of play.

We're not at that level yet, but we think we are making really substantial improvements in the yields of our new technologies coming down the chute. And we track yield and defect density as a function of time, from when we first conceive the technology. The last four generations of technology — each one of them has shaved about a factor of two, in time, to get to the same yield level as the preceding one.

Varian recommends partnering

Thomas Sege, chief executive, Varian Associates Inc., Palo Alto, Calif. Varian Associates is a diversified technology company specializing in semiconductor equipment, analytical instruments and electron tubes.

Q: Given your company's relationship with Tokyo Electron over the years, are there any lessons to be learned about accessing the Japanese market?

Sege: There are a few success stories where wholly owned subsidiaries of American companies have been successful in Japan, but it is a lot harder to get started there. I would say that, in general, the joint-venture route is a more successful one. You move along a great deal faster.

Thomas Sege, Varian Associates

If you accept that technological competence is worldwide, that technology moves fast, that time to market has speeded up, you are, I think, [better off] working in partnership arrangements than somehow making believe that you can do everything better by yourself.

I think a good bit of the problem that the United States sees in the Japanese market is not as a result of regulations and government decisions; it's more a result of culture. We really don't have a good understanding of the Japanese culture, and yet the Japanese culture affects their relationships [with each other] and causes them to buy Japanese.

They're surrounded by service [in Japan]. Service is tremendous there. When a Japanese manufacturer buys equipment from a Japanese supplier, [the supplier] will have several people living at that plant until the equipment reaches 99% up time. No questions asked.

Not only doesn't that happen [in the United States] because, typically, equipment suppliers can't quite afford to do it, but the semiconductor manufacturers don't want to have the equipment supply people in there.

I think, in partnering, you open your vistas. You see the strength of the other company, you bring your own strength and you have a much better chance of expanding your own [business].

Mentor acts for better education

Thomas Bruggere, chairman and chief executive, Mentor Graphics Corp., Beaverton, Ore. Mentor is an electronic design automation company.

Q: Why did you establish a scholarship at Oregon State University?

Thomas Bruggere, Mentor Graphics

Bruggere: It's our recognition — and I think it's everybody's in the electronics industry — that it is going to be more and more difficult to get top-quality engineers, because fewer people seem to be going into engineering as a career. More people are going to be needed than are going to be available.

We see it being necessary to try to [provide incentive for] kids to go into engineering. So we've done a couple of things in that regard [besides the university scholarship]: we've adopted an elementary school, and we're working with kids in that school to give them computer-literacy skills. That's the kind of thing that needs to be done. Companies need to get involved in the educational system at different levels.

Q: What are Mentor's biggest challenges for the '90s?

Bruggere: We have to learn to develop more and manage more remote R&D. For example, today 85% to 90% of our R&D is done in Beaverton. It's all within walking distance by one person in several buildings. As we look forward to the 1990s, I believe we're going to see more and more R&D done in other places. I think we're going to see R&D done in Europe, especially in preparation for 1992. We do some R&D there now. I think the ability to manage those remote activities is going to be really critical for us.

DEC forms strategic alliances

Winston Hindle, senior vice president, Digital Equipment Corp., Maynard, Mass. The minicomputer maker is weathering a downturn and attempting to reposition itself in new markets.

Q: What's Digital's strategy concerning alliances?

Hindle: I think one of the facts of life has been and will continue to be alliances with players in our industry and related industries. I suppose it's obvious that alliances

between software developers and systems developers [make sense]. We know that there's no way we can develop all the software we need in our systems. We are increasingly using alliances to develop joint marketing programs.

I think we will see more and more alliances, although I think they'll be more prevalent in the software area. The percentage of our business that will be software-oriented is going to continue to grow. So we'll be putting more money into software.

Q: Does that involve equity investment?

Hindle: It's a possibility. It's not something we would particularly go out and seek. Actually we would prefer to have arrangements that don't involve ownership of one company by another. We think that companies that can operate as two independent firms, who come together because there's a mutual business interest, are stronger alliances than those that are bought with money.

Winston Hindle, Digital Equipment

Q: What is the government's role in the industry?

Hindle: I think that the United States government doesn't yet perceive that technology is, in fact, global, and consequently it has placed export controls on us and on others who have high-technology products, which puts us at a competitive disadvantage on the global scale.

And they've done this for perfectly reasonable reasons. And that is to protect the technology, which has the potential of giving some other country a military advantage. Obviously, our defense department wants to be sure that the technologies that have a military application, we maintain a leadership in.

But that's been applied across a broad spectrum of technology, much of which the United States does not have any particular advantage in these days. And trying to control a technology in our country, when it is perfectly accessible to our potential enemies, is not a good policy.

Slower growth says Ashton-Tate

Edward Esber, chief executive, Ashton-Tate Corp., Torrance, Calif. The software company serves the database PC and server market.

Q: What's your prognosis for the health of the software business in the next few years?

Esber: I think we are seeing, for the first time, a major slowdown in growth of the business [that's being driven by] a lot of confusion in the marketplace. Longer decision cycles, in part driven by that confusion, in part driven by the fact that as personal computers become more of an integral part of the corporate computing architecture, higher levels of people are involved in the decisions. Which usually is a euphemism for longer decision cycles.

And rightly so. No longer are personal computers a separate piece of iron that sits on somebody's desk. People are talking about connecting them up to the minicomputers and the mainframes, and once you do that you're talking about MIS involvement. In the long run, you're talking about senior management problems.

Edward Esber, Ashton-Tate

Q: How do you see the computer industry growing over the next three to five years?

Esber: Ultimately, I believe that our industry will become like other industries. It will be cyclical. At some point in time, given the global competitiveness, we can't just buy gadgets because they're great new gadgets. We need technology that we can put to work. And certainly, there's been a big gap and the gap is getting wider between the software industry's ability to write and take advantage of the new hardware platforms and the ability of the hardware business to turn out new boxes rapidly.

Compaq announced the 486 when half the world's still trying to catch up with the 286 and 386 operating systems. So, if I was pessimistic I'd say that this business will end up being like the auto industry or the oil business or any business that has up years and down years.

Novell sees distributed control

Raymond Noorda, chief executive, Novell Inc., Provo, Utah. Novell is one of the fastest-growing companies in the networking software business.

Q: What is critical to the success of networking companies in the next few years?

Raymond Noorda, Novell

Noorda: From an industry standpoint, there will be a great transition going on. This will be independent of what the economy is [doing]. The issue is still the rapidity, as it affects our business at least, with which the transition from the corporate controlled environment to the more distributed controlled environment takes place. And that's a function of many things.

One is the need for large companies [to improve] their competitiveness. They need to increase their overall ability to become

more efficient, [have] better communications, more horizontal management. Displacing, perhaps, vertical management so that things can be done more quickly.

Q: What is behind the speed of that transition?

Noorda: Several things. One is the inertia of those large companies. There is also the economy. If [companies] can find ways to cut costs and improve the economy — and distributing processing helps them do that — then that will improve the distributed processing momentum. There is an argument, and I think it is a realistic one, that distributed processing may gain momentum as the capital expenditures or capital commitments get cut.

Everex touts zero-response time

Steve Hui, chief executive, Everex Systems Inc., Fremont, Calif. Everex is a fast growth microcomputer maker.

Q: How does Everex keep competitive?

Hui: We should be a zero-response-time company, compared to the Japanese. What I mean is, we may not have everything in the world but we should be the quickest and the fastest company to get there in terms of the marketplace, in terms of the engineering and technology.

We have to do it from top down as well as bottom up, not just in one phase of our operations. In sales and marketing you want to respond, in manufacturing we want to have very fast production cycles, very fast response. We shouldn't have warehousing if you can match demand or respond to demand instantly. Your inventory should be on your processing lines. The only inventory you should have is raw materials.

The zero-response-time concept ought to be propagated upward from sales and marketing to production, and then to management, which should have a very shallow structure. So we rely on the possibility of people rather than the rigidity of our procedures. In terms of how we do design, we should be much more vertically integrated for fast response.

Steve Hui, Everex Systems

Q: What is Everex's market strategy over the next two years?

Hui: Everex's goal is to become the total solution to the personal computer industry, as IBM is to the mainframe industry. Today we have five different architectures: Apple, Digital, EISA, Unix and IBM. This is the first time that IBM has positioned themselves as only one-fifth of the marketplace. It's a golden opportunity for someone to claim that total solution that you can link and you can connect [all of the architectures]. It's like a general contractor building a house. I am the one that can solve all the problems, just like IBM in the mainframe. I think that is where Everex is going to be.

That means we enter the PC AT, the EISA, the Micro Channel. Even though we don't design the Apple CPU, we should be the most capable company to connect to them. We should be the most capable company to solve any conflict in any business environment.

Tandem learns a new vocabulary

James Treybig, chief executive, Tandem Computers Inc., Cupertino, Calif. Tandem supplies on-line transaction-processing systems and enterprise-wide networks.

Q: What are Tandem's biggest challenges for the 1990s?

James Treybig, Tandem Computers

Treybig: The most important thing about technology companies is that change is for sure. You must keep forcing your company to change, to move. The '90s will be a time when there continues to be tremendous change toward standards, which puts a burden on companies that continue to search for advantage in standards. Many companies that can't change to the new function are going to have serious problems.

So every decade you have this evolving, changing role of the technology, and you've got to keep moving. The easy part is the technology. The harder part is to move people, to move thought, to move understanding.

Right now, [everybody in the company has] to learn the "words of the '90s" so they can stand up and give a speech on Unix for three minutes. Every person. So it's a systematic way of forcing the understanding of our new direction, continually.

Q: What are the words of the '90s?

Treybig: For Tandem, they are the words of database. They are the words of RISC [reduced instruction set computer] technology. They're the words of new concepts of storage. They're words of tools. Open architectures will let customers use whatever tool they prefer. They're the words of Unix. To succeed, you've got to force an understanding of the new places you're moving to.

Telephones are a part of the world in the future. This connectivity and integration of computer systems — a big part of it is going to be [by] telephone. And we're working hard to be the big winner in that huge market.

Q: How can you balance the introduction of new products with the increasing need to service your installed base? Is there a shift going on?

Treybig: No, we don't have a shift toward service. The key in service is not that it becomes a big part of your

business, but it's that you're very careful what [service] business you're in.

What do we want to be known for in service? We want to be known as the people who can support high technology. We want an image of Tandem that [we] support and can service the most sophisticated and newest technology. I think that's good margin.

You have to look at service as part of the product. But all the accountants at Tandem keep wanting to make it separate, and it's dysfunctional. I mean, I just have to keep having energy to go back and fight them because you can't separate [service].

Arrow transforms itself

Stephen Kaufman, chief executive, Arrow Electronics Inc., Melville, N.Y. Arrow Electronics is an international distributor of electronic components and computer systems.

Q: What is your strategy for computer systems versus components?

Kaufman: What we see is that the markets are different, in that the process of designing in and selling a component is inherently different from the process of designing in and selling a full-bore computer system. And the subsystems are somewhere in between. The markets are different and need to be approached differently.

Our strategy has been to separate those two business groups and to treat them and manage them differently. On the component side, the margins run in the mid-20s and we have branches in 35 cities and a lot of field support. For computer systems, the margins are 14% to 15%, they're much more centralized, much more telephone, much less face-to-face, because you have to do that to live on 14% to 15%.

Stephen Kaufman, Arrow Electronics

We are in the process of transforming ourself from a single company to a company that has multiple operating units, each fairly independent and autonomous and each serving the market segment that we are able to define. We were one company eight years ago. By the end of 1990 we will be effectively six operating units under a common umbrella. By using common MIS, warehousing, financial, human resource, personnel and marcomm [marketing and communications] resources. So what we try to say is, let's focus a little on markets and build operating units that focus, but let's also take advantage of scale and size where it makes sense.

Q: Do you see distributors getting more actively involved in systems integration?

Kaufman: The issue of getting into systems integration is one that we at Arrow are treating with a great deal of respect and some trepidation. In our computer systems businesses, we have one division, MTI, that is basically a big systems integrator in about half of its business.

In my own mind, I am not sure that the typical distributor, even one that distributes computer products, has all the skills and experience to be widely successful in the integration business. I know a lot are trying it, but I have a deep sense that the things you learn to do well to be a good distributor may not be the things that help you become a good systems integrator.

AST wants export decontrol

Safi Qureshey, chief executive, AST Research Inc., Irvine, Calif. AST is a leading technology-driven microcomputer and add-in board maker.

Q: What are some of the macroeconomic problems the industry faces?

Safi Qureshey, AST Research

Qureshey: There are some structural issues in the U.S. economy with some of our major trading partners that need addressing. From the high-tech community's point of view, there are the trading restrictions and requirements. We have to comply with the export licenses. Our country is the most restrictive as far as the regulations are concerned compared to many of our trading partners.

As the technology gap between the products that we provide and what other countries provide, shrinks, the [foreign] customers are not willing to wait that long.

We still have inter-agency issues between the State Department, the Defense Department and Commerce Department. It is still a joke that the day the 286 was liberalized by the Department of Commerce, the Secretary of Defense went on TV and said that exporting 286s was comparable to exporting B-2 technology. But the thing is, if you don't get a chance to export those 286s, there won't be any money for B-2s.

Q: How will standards evolve in the next few years?

Qureshey: I think we are adjusting to the new realities in our business, which is more standards and more competition. The trend in standards is really forcing a major dislocation on the traditional players in our industry. We see a major restructuring in the information processing industry. We see a major dislocation in the minicomputer and mainframe segment.

I think it will be traumatic. I think if you look at the layoffs that are going on, that is just the start. We believe that the financial model has changed for our industry, and we really cannot expect to run our businesses on 50% to 60% gross margins. □

METHODOLOGY

Defining electronics

A microcosm of the U.S. electronics industry. A look at the companies surveyed, their markets and where they operate

The U.S. electronics industry is one of the largest and most dynamic industries in the world. It employs more people and is responsible for more revenue than any other industrial segment in the country. But because of the constant influx of new products, new technologies and new companies, "electronics" is not an easily definable industry.

Lacking a universally accepted definition, the ELECTRONIC BUSINESS/Ernst & Young survey team developed its own. From the Ernst & Young High Technology Group's database and from ELECTRONIC BUSINESS' own files, a list of 3,200 company names, reflecting the breadth and diversity of the electronics industry, was developed.

An eight-page survey was sent out in September 1989 to the chief executives of companies on the list. By the end of October, 774 chief executives had responded, for a response rate of 24%. The results were dissected and cross-referenced in three ways: by revenue size, by market segment and by funding. For the most part, survey questions were analyzed based on the number of responses and were not weighted according to revenue or employment figures.

The companies surveyed closely parallel the industry. For instance, according to the American Electronics Association, the U.S. electronics industry has an average revenue per employee of $105,682, compared with $107,000 for the survey.

Market segments

Market categories represent all the links in the electronics food chain, from components to systems. Computer and peripherals companies make up the largest category, followed closely by industrial electronics and semiconductor manufacturers. Together, these three original equipment manufacturer (OEM) categories account for nearly 60% of the survey sample in terms of number of companies (Chart 1).

Each category contains companies with similar supplier and customer bases, similar cost structures and similar management concerns, with the exception of the semiconductor and "other" categories. Eleven percent of the semiconductor category is made up of semiconductor equipment manufacturers. These companies are included here because they are so closely linked to the semicon-

CHART 1

SURVEYED COMPANIES BY MARKET SEGMENTS

	Number of companies	Total revenue	Total employment	Segment definition
Computers	20.7%	17.9%	19.7%	Micros, minis and mainframes (52%), peripherals (48%)
Industrial	19.7%	8.0%	15.3%	Test and measurement (75%), factory systems (15%), medical electronics (10%)
Semiconductors	18.9%	35.6%	25.2%	Semiconductors (37%), semiconductor production equipment (11%), printed circuit boards (5%), other active and passive components (47%)
Software	16.2%	3.4%	7.8%	Software developers (75%), systems integrators (12.5%), CAE/CAD (12.5%)
Communications	9.8%	13.7%	10.6%	Telecom equipment (80%), network systems (20%)
Aerospace	6.5%	19.2%	18.2%	Prime and subcontractors
Other	8.2%	2.2%	3.2%	Consumer electronics (25%), technical services and consulting (12.5%) contract manufacturing (12.5%), other (50%)

Percentage of total respondents

METHODOLOGY

ductor industry. The semiconductor category also includes other component and printed circuit board makers. The "other" category includes consumer electronics companies, consultants and other companies that do not fit easily into the six main categories.

Although most companies surveyed share a common business environment, aerospace and defense companies are the exception. As their end customer is the Department of Defense, their management concerns often differ from those of companies in the commercial markets. Aerospace and defense electronics is the smallest category in terms of number of companies but generates a significant percentage of the industry's total revenue.

Revenue size

The survey is biased toward small, growth-oriented companies, which closely mirror the industry's form. Sixty-seven percent of the companies surveyed have sales below $25 million. Large companies, however, employ the most people and generate the most revenue. Companies with annual sales of $300 million and above account for half the total employment and 84.5% of total revenue for the sample (Chart 2).

The developing company category is made up of young high-growth companies; most of them are privately owned and usually backed by venture capital. Within the next five years, 47% of these companies expect to go to the public markets for funds, and 67% expect to be acquired. Their outlook for the future tends to be optimistic, since they are divorced from economic and industry cycles.

Small companies also are mostly private and carry the highest level of debt. Although only 6% today are public, 30% expect to be traded publicly within five years. Like developing companies, small companies tend to be tied to their technology; are fighting for market share against larger competitors; and are worried more by tactical issues than by strategic issues.

CHART 2

SURVEYED COMPANIES BY SIZE

	Number of companies	Total revenue	Total employment	Company sales
Top-tier	6.4%	84.5%	51.1%	$300 million and above
Large	7.6%	7.5%	15.9%	$100 million to $300 million
Midsized	18.8%	5.0%	17.0%	$25 million to $100 million
Small	34.3%	2.5%	11.6%	$5 million to $25 million
Developing	32.9%	4.0%	4.4%	Less than $5 million

Percentage of total respondents

The midsized company category is a mix of both high-growth, young companies and mature, well-established companies. The new stars of the 1990s will come from these ranks. Only 20% are publicly traded today, but 39% expect to be traded in five years.

Large companies are concentrated in the computer and semiconductor markets. This group of companies is looking to expand overseas while it also faces the greatest threat from foreign competition. Twenty-six percent currently are public; 35% expect to be public in five years.

The top-tier company category averages $2.2 billion in revenue and contains the industry leaders in their fields. Forty-one percent are publicly held, and that figure is not expected to change much in the next five years. Like companies in the "large" category, they are concentrated in the semiconductor and computer markets. Although they are large, they recognize their vulnerability: 18% expect to be acquired within the next five years.

Surveyed companies were categorized by funding sources: public, private, domestic subsidiary and foreign subsidiary. In general, private companies are small and public companies are large. Eighty-five percent of the private companies surveyed have annual revenue below $25 million, while 67% of all public companies have revenue of $25 million and above. Foreign subsidiaries are populous in the computer and peripherals market and least populous in the aerospace and defense electronics market. Domestic subsidiaries are concentrated in the aerospace segment. In general, foreign subsidiaries have higher annual sales than their domestic counterparts (Chart 3).

Whether domestic or foreign, nearly 40% of all companies surveyed are located in Northern California. Southern California is the second most popular corporate location, with 17.5% of total respondents, and Massachusetts is third, with 8.4%. Other major centers are Texas, Washington and Oregon. The unexpectedly high California concentration introduces a West Coast bias into the sample, but in general the sample reflects the regional distribution of the industry. According to AEA statistics for 1987, the most recent data available, California topped the location list with 26% of the industry's employment.

BRUCE C.P. RAYNER

CHART 3

SURVEYED COMPANIES BY FUNDING

			Subsidiaries	
	Public	Private	Domestic	Foreign
Computers	20.1%	57.1%	8.5%	14.3%
Industrial	18.8%	67.1%	8.7%	5.4%
Semiconductors	17.9%	57.9%	16.4%	7.8%
Software	11.7%	81.7%	1.6%	5.0%
Communications	26.4%	59.7%	5.6%	8.3%
Aerospace	23.0%	45.8%	22.9%	8.3%
Other	16.1%	62.9%	12.9%	8.1%

Percentage of total respondents

Gridlock on the airways blocks U.S. cellular growth

Carriers hope new digital technology will ease the network traffic jams created by mobile phone fever. But how long will the switch to digital take?

BY DWIGHT B. DAVIS

In car-crazed Los Angeles, traffic-jammed commuters have embraced mobile cellular phones with the same passion once reserved for automobiles themselves. But the phones' popularity has become a mixed blessing for the local cellular carriers. While racking up record revenue, the network operators are struggling to cram new subscribers into a system already straining under the current load.

No other U.S. city is yet pushing the cellular wall like Los Angeles, but metropolitan areas such as New York, San Francisco, Chicago, Detroit, Miami and Washington, D.C., are fast closing in. Faced with capacity limits inherent in the current mobile phone network — which uses bandwidth-gobbling analog radio waves to transmit signals — the carriers are pressing for new equipment that employs more efficient digital transmission techniques.

An emerging digital standard promises relief for congested cellular systems, although industry bickering over a few technical points could delay its ratification. Along with boosting system capacity, digital cellular systems will permit operators to offer a suite of mobile phone services ranging from voice encryption to data transmissions to on-line burglar alarms.

Network equipment suppliers and phone manufacturers are gearing up to produce digital cellular equipment for initial shipment late this year or in early 1991. Most major U.S. carriers expect to start introducing digital cellular service sometime next year, with the early focus on the markets already pushed to the limit.

The move toward digital occurs against a backdrop of spectacular growth and industry consolidation.

In 1984, when commercial cellular systems were introduced, the networks attracted just over 90,000 subscribers; by mid-1989, the subscriber base totaled nearly 2.7 million and was growing at a rate of more than 104,000 users per month — two or three new subscribers every minute — according to the Cellular Telecommunications Industry Association.

Carrier revenue for the first half of 1989 surpassed $1.4 billion, the CTIA reports. And through June 1989, the industry's capital investments exceeded $3.6 billion.

Cellular agglomeration

In the United States, the cellular industry is spread throughout 305 "metropolitan statistical areas" and 428 "rural service areas." The Federal Communications Commission licenses two cellular carriers for each MSA and RSA: one carrier must be

Jo Ann Blount, director of market planning: BellSouth Mobility plans to begin installing digital cellular systems in its crowded south Florida market sometime during 1991

a "wireline" operator that already provides local phone service in the area, the second "nonwireline" carrier is not involved in local phone operations in that particular area, although it may be a local phone company in some other market.

Escalating cellular revenue has set off a flurry of mergers and acquisitions within the industry. The most notable is market leader McCaw Cellular Communications Inc.'s $3.4 billion acquisition of a majority interest in New York City-based Lin Broadcasting Corp. The deal, which was to have been consummated in late February, gives Kirkland, Washington-based McCaw rights to cellular markets with a total potential customer base ("pops" in industry jargon) of about 70 million people.

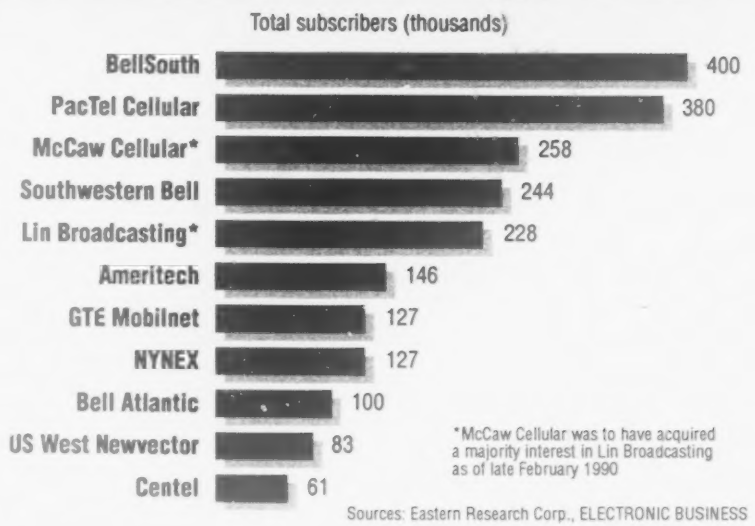
Among the regional Bell operating companies, BellSouth Corp. and Pacific Telesis Group are particularly active players. BellSouth was negotiating a deal with Lin before being blindsided in December by McCaw's more lucrative offer. At the start of 1990, Atlanta-based BellSouth's two cellular subsidiaries — BellSouth Mobility Inc. and American Cellular Communications Corp. — had just over 400,000 subscribers and a total pops of 27.9 million.

For its part, PacTel Cellular, based in Irvine, Calif., had a presence in markets totaling 30.8 million pops and a base of 380,000 subscribers at the start of the year. With demand for cellular service booming, "the industry will certainly see more consolidation in the future," predicts Justin Jaschke, vice president of corporate development at the company.

Consolidated or not, industry carriers operating in some of the more crowded metropolitan areas are crying for relief. The frequency spectrum allocated for mobile phone traffic is far too limited to meet demand growth; a single analog cell supports, at most, fewer than 60 simultaneous voice channels.

The beauty of the cellular concept is that subsets of the available frequencies can be reused in multiple cells throughout any given city to support thousands of simultaneous calls. Each cell has a central, low-power antenna just capable of reaching the cell's boundaries. Adjacent cells use different calling frequencies to avoid call interference, but cells separated by some minimum distance can use identical radio frequencies.

Leading U.S. cellular phone carriers — 1989



Sources: Eastern Research Corp., ELECTRONIC BUSINESS

In cities with heavy cellular use, carriers can add capacity by continually subdividing existing cells and reducing the power of the central antennas. But there are limits to this strategy.

"The practical limit for an analog cell size is about a one-mile radius, after which interference becomes too much of a problem," says PacTel's Jaschke. Even without this technical constraint, economic and access considerations can curb cell splitting.

By mid-1989, the subscriber base was growing at a rate of 104,000 users/month

The equipment and facilities for a typical cell site cost anywhere from $500,000 to $750,000, according to various industry estimates. Even if a carrier can justify the cost of new cells, there may be no appropriate locations to build the new facilities.

"In some markets, cellular operators are running out of real estate that they can afford or that is zoned for commercial use," says Dick Snyder, business development director for cellular systems at AT&T Network Systems Inc., a major supplier of cellular networking equipment.

Digital techniques offer a solution to the capacity problem because three or more digital channels can be squeezed into the same bandwidth as a single analog voice channel. In a draft standard for digital being circulated by the Telecommunications Industry Association, three digital channels would replace each analog.

Barring substantive changes requested during the balloting process, the draft standard could be accepted and published sometime this spring, according to Eric Schimmel, vice president of the TIA. But already the standard is firm enough that "99% of the development of digital systems is possible now," believes Piyush Sodha, director of product line management for cellular systems at Northern Telecom Inc. in Atlanta.

As network equipment suppliers and mobile phone manufacturers gear up to produce digital products, the carriers are devising strategies to move smoothly from an analog to a digital infrastructure. "The traffic engineers will have problems balancing the rate of conversion with the analog and digital demand," predicts Jo Ann Blount, director of market planning at carrier BellSouth Mobility in Atlanta.

The interim result will be hybrid cells, with the available frequency split in some fashion between analog and digital channels. "There is a traf-

fic engineering ballet that must play out," says Mark Ripley, vice president, network, at GTE Mobilnet Inc. in Houston. "The conversion rate will depend on the customer usage of digital phones."

Carriers have an economic as well as a capacity incentive to encourage their subscribers to switch to digital. "The radio card that provides digital channels costs only about 20% more than an analog card, but supports three times as many channels," notes AT&T's Snyder.

"In our markets, there is no pressing need for us to move to digital," says Stuart Heffernan, senior vice president, network, at Contel Cellular Inc. in Atlanta. "But there may be an economic benefit to switch to digital channels even in the absence of capacity demands."

A potential hitch in this entire scenario is that the prices of the first digital phones could be considerably above the $400 to $600 now charged for basic analog units. If so, users may need some incentive to trade up to digital.

Three options exist to draw subscribers to the digital realm: the carriers can subsidize the costs of the digital phones to bring them in line with their analog counterparts; carriers can offer discounts on digital "air time" usage fees relative to analog fees; or the cellular operators can provide digital services so attractive that users make the switch even if a phone cost penalty exists.

"We don't want to do subsidies," says Blount at BellSouth. "We want the phone manufacturers to get equipment out at a price within 10% of the analog phone prices." Still, she admits, "The first [generation of] digital won't have that many new features to attract customers."

As the industry gears up for digital, most players are keeping a wary eye on a new technology that could play havoc with cellular's long-term prospects. Called personal communications networks, the mobile phone technology is up and running in Britain, where it competes directly with cellular networks.

Getting personal

PCNs, as they are called, operate at a higher frequency than cellular, and have a shorter range. But the PCN network equipment is less expensive than its cellular counterparts and PCN phones are smaller and cheaper than most cellular units.

The FCC has received two petitions for allocation of the PCN frequency spectrum in the United States, with one petition coming from a subsidiary of Millicom U.K.,

Digital standards: Almost all for one

More than a year ago, the cellular industry coalesced behind one of the key standards needed to effect digital mobile communications. That standard defines the access method via which multiple digital channels can operate over the same bandwidth now allocated for a single analog channel. The access method chosen, Time Division Multiple Access or TDMA, won out over an alternate technique, Frequency Division Multiple Access or FDMA.

The current draft standard specifies the replacement of each analog channel with three digital channels. Since the TDMA specification was established, however, one major carrier, PacTel Cellular, has questioned its long-term efficacy.

Worried that even a three-fold capacity increase won't satiate high-demand markets such as Los Angeles, PacTel Cellular has floated yet another access method, known as Code Division Multiple Access or CDMA.

In November, PacTel Cellular and partner Qualcomm Inc. ran a demonstration of CDMA in San Diego. "We believe CDMA will provide greater capacity than TDMA," explains Justin Jaschke, vice president of corporate development at PacTel Cellular. The company hopes that CDMA might support as many as 20 digital channels for each analog, he says.

Others believe the potential of CDMA remains an open question, not a sure thing. "CDMA does have some advantages over TDMA," says William J. Hilsman, president of International Mobile Machines, Corp. (IMM) of Philadelphia, "but there are still many unresolved technical issues."

Some believe the potential of CDMA is an open question, not a sure thing

In Hilsman's opinion, TDMA can rival the capacity potential of CDMA, and can do it within the boundaries of the proposed cellular standard. IMM, which claims to hold a number of dominant TDMA radio access patents, already runs four digital channels over a bandwidth smaller than that now occupied by a single analog cellular channel. "We can offer the option within the standard to go to six channel," Hilsman says, noting that IMM hopes to use TDMA to support as many as 32 digital channels in the available bandwidth.

The time-division access standard seems to enjoy broad industry support, at least for the first generation of digital cellular. "We support TDMA and we need digital cellular in 1991," remarks Jo Ann Blount, director of market planning for BellSouth Mobility. "We can't afford this start/stop process anymore."

Eric Schimmel, vice president of the Telecommunications Industry Association, says the CDMA proponents never presented their case before the TIA's standards committee, and he views the current attempt to raise the issue as "a day late and a dollar short." Still, he says, "We're not rejecting CDMA out of hand for, perhaps, the third generation of digital."

Meanwhile, despite the company's ongoing investigation into CDMA, "We have no interest in doing something different from the rest of the industry," PacTel's Jaschke claims. "We support industry standards. It's just that we have some specific needs in our markets." □

Ad Council

LEARN HOW TO JUMP-START A LIFE.

Learn Red Cross CPR.

one of the license holders for the British PCN system. While most of the U.S. cellular operators are closely tracking the PCN activity in their backyard, few feel threatened by the technology yet.

"The drivers for PCNs in the U.K. are different from those in the states," says GTE's Ripley. "In the U.K., there is a pent up demand for basic phone service and pay phone stations, and PCNs represent a substitute for those services."

PacTel's Jaschke concurs, and says, "We don't see a need to allocate spectrum for PCNs, since [digital cellular] can provide all a PCN could. As a result, we're encouraging the FCC to take a hard look at what the PCN petitioners are proposing." □

Digital phones: One step backward?

Manufacturers of mobile phones have continually built smaller and less-expensive units. Motorola Inc.'s General Systems Group, for example, markets the Micro TAC Cellular Personal Telephone, which, with its battery, weighs only 10.7 ounces. Basic phone prices, meanwhile have dropped from more than $2,000 a few years ago to average $300 to $500 today.

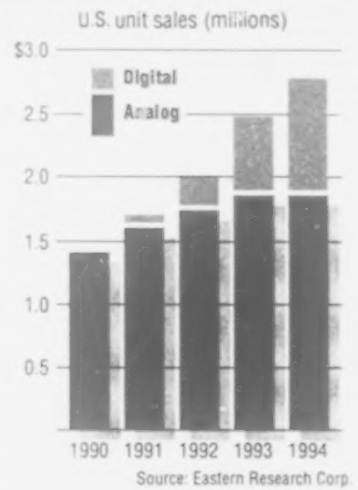
The advent of digital cellular technology may throw this progression backward. Despite the perception that digital techniques generally result in smaller and lower-cost products, the reverse is likely to be true for the first generation of digital cellular phones.

Part of the reason for this reversal is that the first of the future phones will have to be dual-mode devices that support analog as well as digital communications. An all-digital phone won't work in cells that have not yet converted to digital technology. As carriers shift over to digital services, customers' phones must be able to switch between analog and digital transmission depending upon the technology of a particular cell site.

In addition, says Jim Caile, director of marketing at Motorola's Cellular Subscriber Group in Arlington Heights, Ill., the digital technology itself demands fairly expensive and numerous components. "A digital phone must have about 100 times the processing power of an analog phone," he says, "and may have five times as many integrated circuits."

Analysts estimate the additional complexity of dual-mode phones may result in prices anywhere from 10% to 200% above their analog counterparts. Digital components will also add bulk to the units, since they must continue to support analog functions as well.

Analog vs. digital in mobile phones

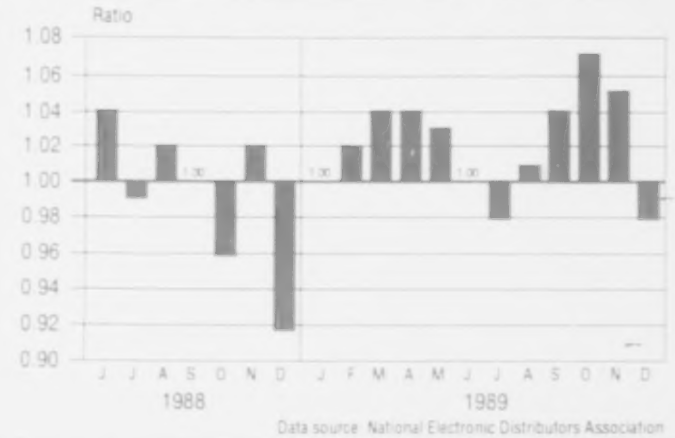


Source: Eastern Research Corp.

The increased bulk could have an impact on the growing popularity of handheld "portable" phones. "In some markets, portables account for 70% to 75% of new phone sales," says Jo Ann Blount, director of market planning for carrier BellSouth Mobility.

Blount worries that it may not be practical to squeeze bulky digital technology into the kind of lightweight unit that merits the "portable" designation, a physical constant that could slow the overall market's acceptance of digital. But Caile says, "We believe a dual-mode portable is achievable," although he believes the first available dual-mode products will be larger mobile phones designed for installation in cars. □

Distributors' book-to-bill slips in December...



Data source: National Electronic Distributors Association

...while new orders see year-end surge...

Data source: National Electronic Distributors Association

...so shipments should see mild downturn in 1990

Data source: National Electronic Distributors Association. Forecast: Cahners Economics

Distributor orders surge at year-end 1989

Surprisingly, new orders to distributors surged upward at the end of 1989, according to data released by the National Electronic Distributors Association. After falling below year-ago levels for nine consecutive months beginning December 1988, new orders grew 7% in September, 15% in October, 12% in November and 11% in December this past year. I had forecasted a 5% decline in distributor orders in the final quarter of 1989 compared to 1988 fourth quarter levels. Instead, orders actually rose 1.3%.

This turnaround in orders may be a leading indicator of a stronger 1990 ahead than most business news headlines anticipate. A question remains: is the year-end advance in orders indicative of a trend for this year or is it just a momentary spurt in activity?

The news from distributor orders is indeed encouraging. But I had never expected the distributor industry to take a bath in 1990 anyway. In fact, six months ago, I forecasted distributors shipments to rise 5% in 1990. My forecast for 1990 is slightly lower now at 2.8%. Most likely, last year's leap in orders has stolen some growth from 1990. All in all, 1990 should be a year of relative stability for distributors: don't expect great growth or dismal declines in shipments.

Remember, a report of just one number does not indicate a trend. Since the industry is clearly nearing a turning point in early 1990, we can expect aggregate data from distributors to jump up and down month-by-month a bit more now. So don't let headlines about a one-month plunge in distributor book-to-bill ratios mislead you. At this stage in the business cycle, chances are next month's book-to-bill ratio will jump back up.

Also, don't make the mistake of comparing distributor orders in December to orders of the previous month. Unlike the Commerce Department shipments and orders that are adjusted for seasonal trends, which we report regularly, distributors data are not so adjusted. Compare the monthly number to the same monthly number of the previous year. Then the trend is a bit clearer.

As soon as we digest the first quarter 1990 data, we should have an even better idea of how to read the 1989 year-end orders surge and its impact on the forecasts.

ELIZABETH B. BAATZ, Cahners Economics

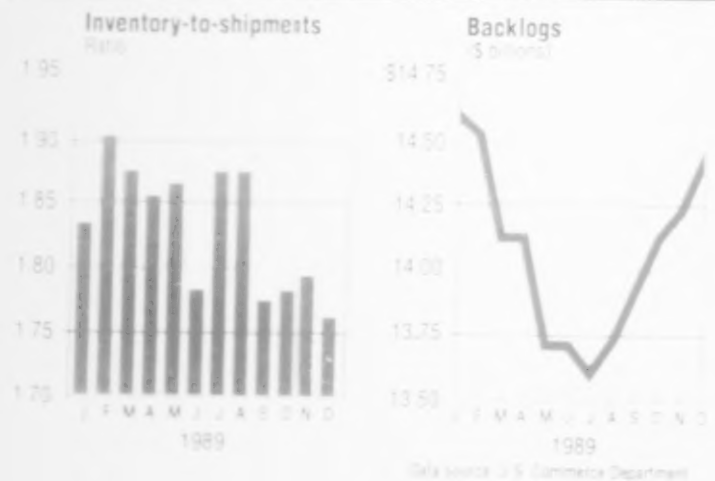
Dollar levels of component shipments stable...

Data source: U.S. Commerce Department. Forecast: Cahners Economics

...while shipments growth stumbles in 1990

Data source: U.S. Commerce Department. Forecast: Cahners Economics

I/S ratios still low and backlogs head back up



Data source: U.S. Commerce Department

Slow growth pushes up component shipments

Slow growth in the final quarter of last year has pushed U.S. factory shipments of electronic components to new heights. A record-breaking $14.8 billion worth of resistors, semiconductors, printed circuit boards, capacitors, connectors and other devices were shipped from U.S. merchant producers in the last three months of 1989. Compared to a year ago, component shipments grew 5.7%, accelerating slightly from the meager 2.2% growth rate of the third quarter.

All told, U.S. merchants sold $57.9 billion of components in 1989, excluding corporate overhead and profits. Because shipments grew 16% in 1988, last year's slower 6% gain caused some concern for manufacturers.

The economic predictions for components and other electronic markets will be more difficult to make this year because a business cycle turning point is clearly in the offing. As this turning point nears, a three-month margin of error either way in our forecasting is significant.

What can be said about the component outlook in 1990 with confidence? Cahners Economics forecasts don't expect component shipments growth to pick up too much in 1990. In fact, the forecast calls for a 2% decline in annual shipments this year, followed by a 13% increase in 1991. The likelihood of a severe decline in shipments remains remote. While the industry faces its turning point growth trough this year, the low of 1990 will not be similar to the low of 1985.

Here's some supporting evidence: inventories at component factories are not rising as expected during this period of slumping demand, but falling. After twenty-eight consecutive months of rising inventory (over year-ago levels), inventories fell 1.1% last November and 0.6% last December. At the current sales rate, only 1.76 months of inventory, a new record low, stood ready on hand last December.

More evidence from the U.S. Commerce Department: backlogs have been creeping back up. Hitting a low of $13.6 billion last July, backlogs rose to $14.4 billion by December. For reference, backlog levels peaked at $15.8 billion in June of 1988.

ELIZABETH B. BAATZ, Cahners Economics

For more information about Cahners Economics forecasts and track records, please write Dan Buchan, Cahners Economics, 275 Washington Street, Newton, MA 02158-1630, or call 617-558-4758 or telefax 617-558-4402.